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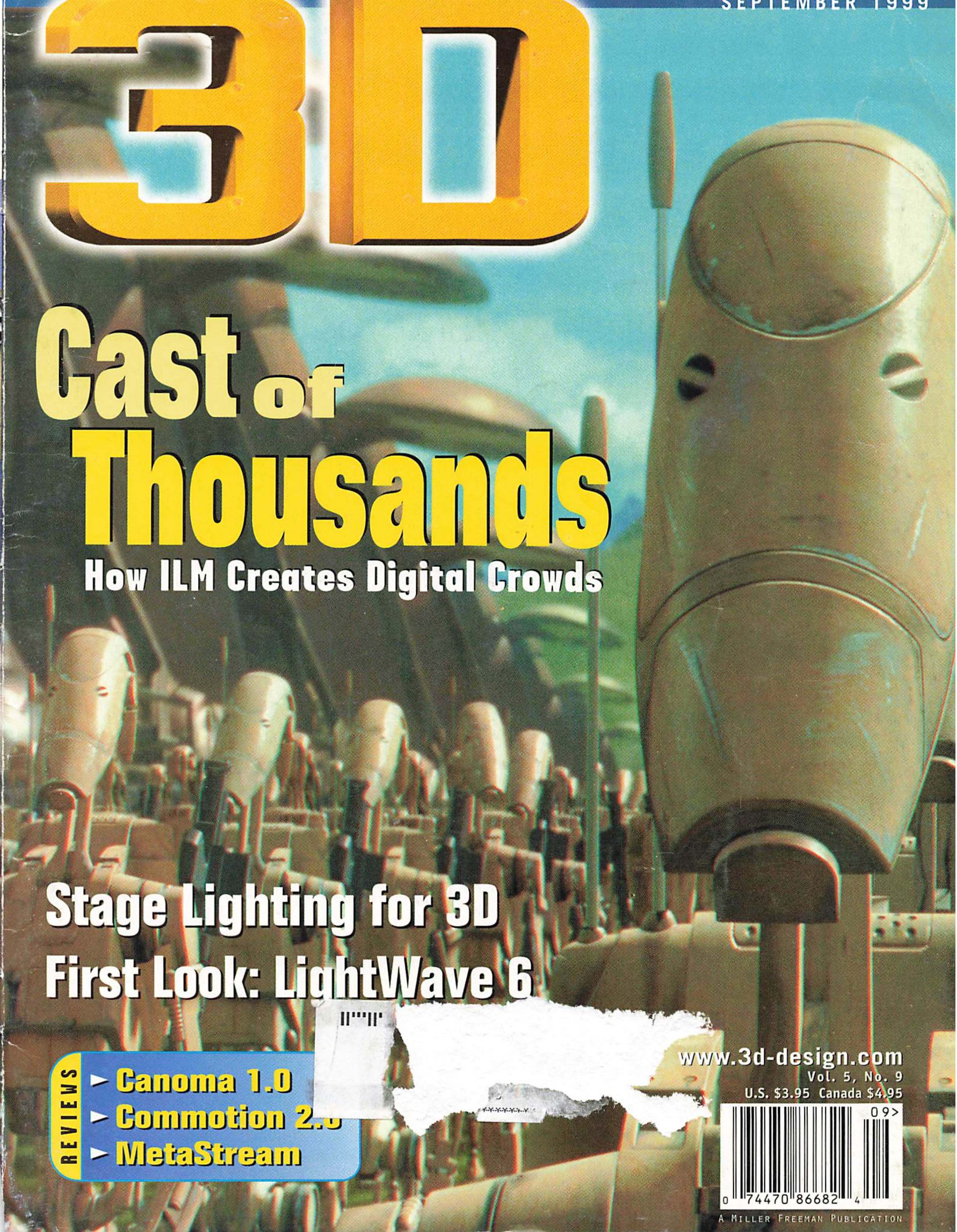

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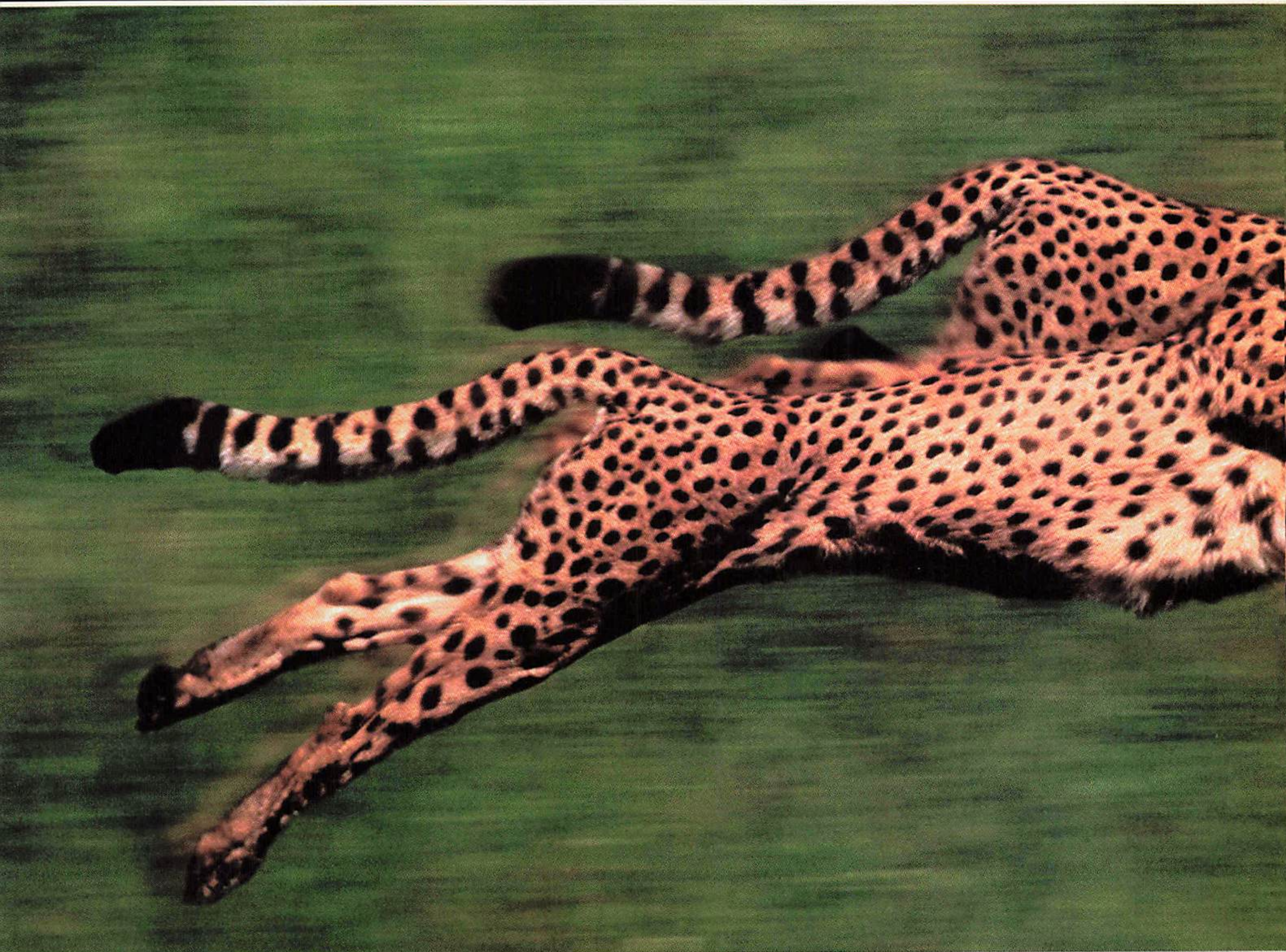

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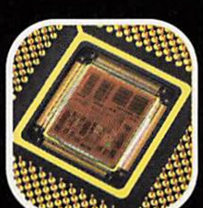

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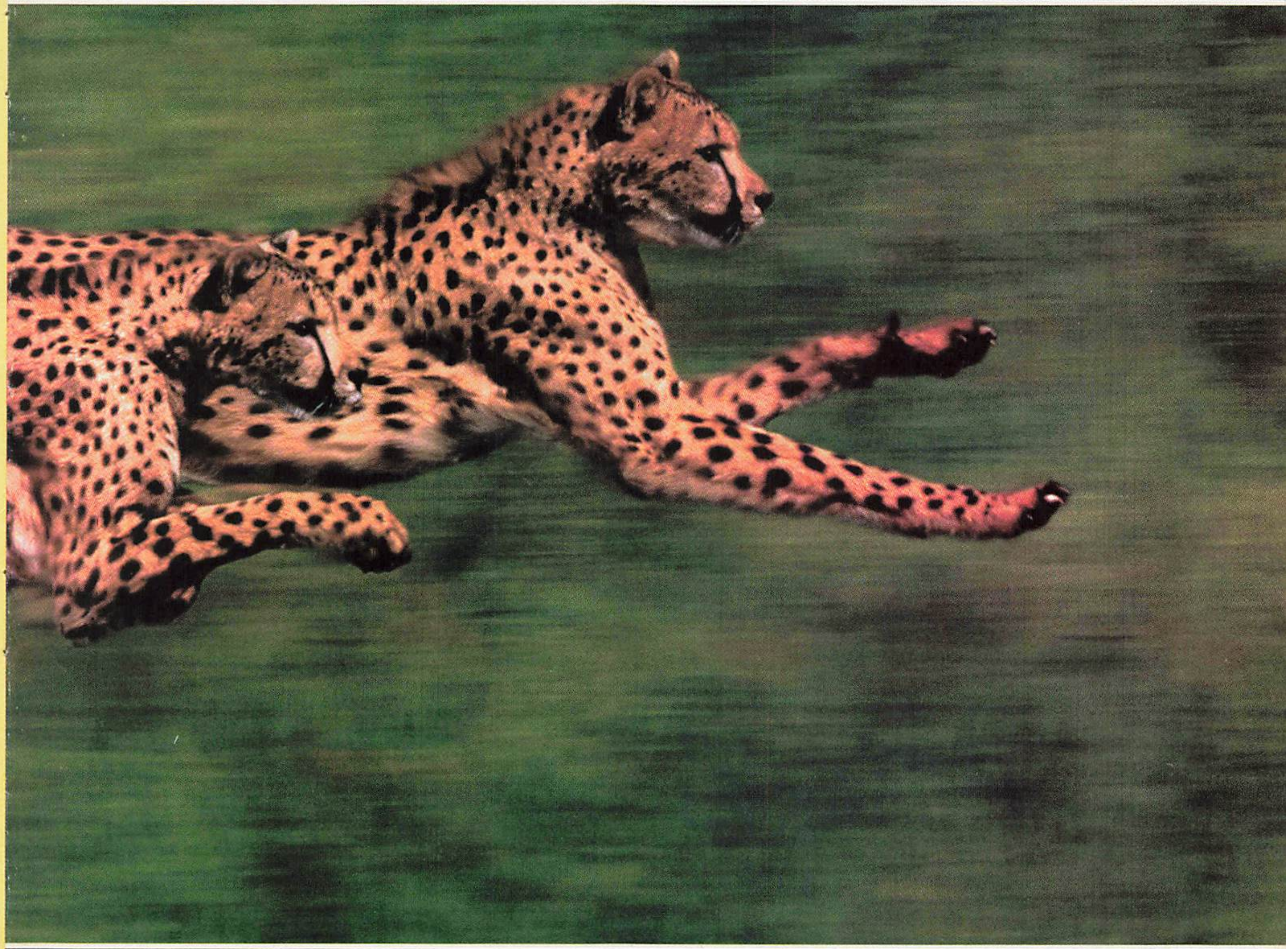

3D September 1999

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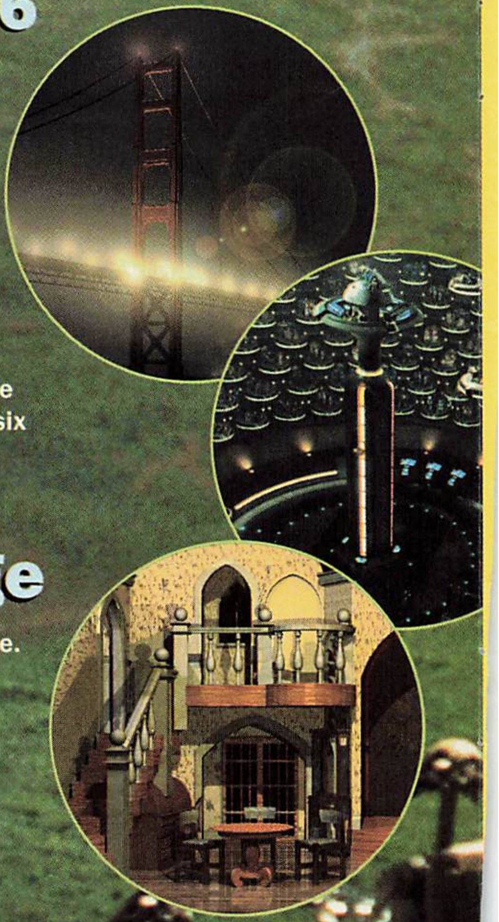

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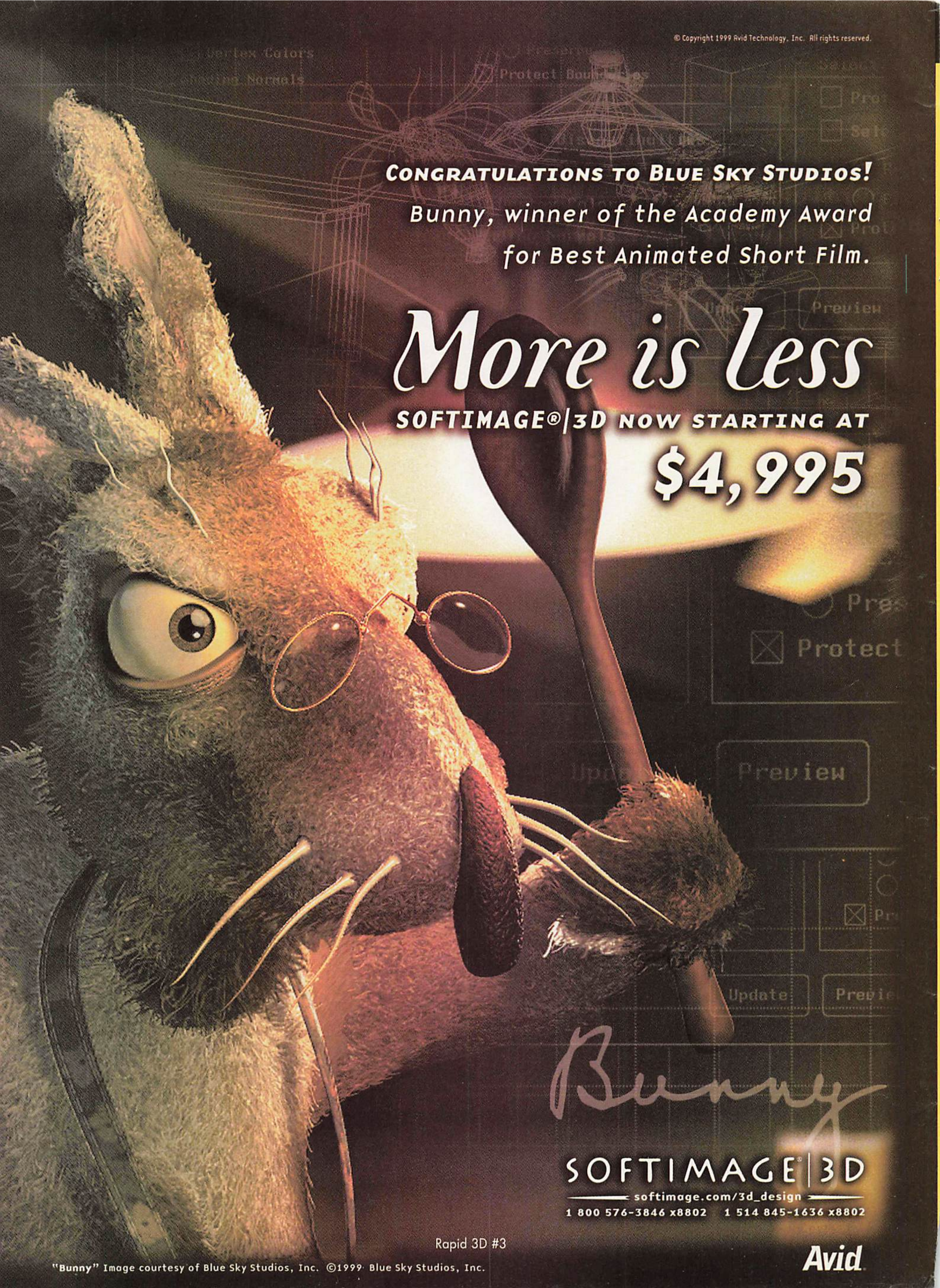
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OUT OF MY M!ND

Print vs. the Internet

The Internet presents a challenge to publishers just like everyone else. When you can type a few words into a search engine and get the information you need, is there still a reason to flip through paper pages? When enthusiasts can distribute tutorials at virtually no cost, is there a need for *3D* magazine?

We've answered these questions sufficiently to know that we want to continue making a top-quality magazine for 3D artists and animators—while developing a web site, 3D Experience, to supplement it—and presumably you've answered them sufficiently to be reading these words. But the Internet continues to challenge us, and we must continue to refine our notions of how best to use it.

Most nettlesome, at least to editors accustomed to a three-month lead time, is the Net's amazing capacity to disseminate news. Each month, we send our news section to the printer knowing that many readers will get the facts elsewhere first. This reality provided the impetus for our newest venture, a monthly electronic newsletter called *3D Direct*. (You can subscribe via the *3D* web site at www.3d-design.com.)

First and foremost, *3D Direct* is a way to get news from our screens to yours pronto. Each month, we gather the most significant developments in 3D software, hardware, business, and artistry and post them to the Web immediately. Then we send out an email to let you know where to find them. You get the news you need without waiting months for it, and we reclaim precious magazine pages to present the news in a fuller context.

But our *3D Direct* newsletter is more than news. It's a conduit for information that would be unlikely to appear in print at all, early or late. Journalistic standards on the Internet are evolving independently of print media. A web-based newsletter offers license to publish things that would seem, well, *outré* in the pages of *3D* magazine.

Like what? Like "Eternal Truth of the Month," a regular column by our anonymous online mystic, Swami Rendananda. Each month, the esteemed Swami interprets current events in digital graphics in light of the perennial philosophy of visual artistry (not to mention his vast accumulation of experience as a 3D professional). The Net, of course, is a swamp of information of uncertain provenance. I don't relish the muck, but the Swami's crystal ball would cloud over if his anonymity were breached, so the Net seems a perfect medium for his meditations.

Insight is a rare commodity, yet conventional print journalism often passes it up to avoid conflicts of interest. This is as it should be; you need information about high-tech artistic tools free of the influence of those who make and sell them. But given that *3D* magazine serves that need, why not use the online medium—where traditional conflicts of interest are being transmuted into new models of commerce and culture—to convey insight that otherwise would have no outlet?

3D Direct's first foray into the heart of editorial darkness is "On the Horizon," a regular column by publicist Jonathan Hirshon. Architect of PR and marketing campaigns for SGI, 3Dlabs, and Apple, Hirshon has been counseling digital graphics vendors for over a decade. To keep the proceedings from becoming an all-out shillfest, I've forbidden him to discuss current clients without identifying them as such. So far he hasn't mentioned a single one. Instead, he has provided rock-solid industry analysis the like of which you won't read anywhere else.

Our online newsletter is only in version 1.0, and future revs will be shaped in large part by feedback from readers. I invite you to take a look and send me your reactions. With your help, we'll use both print and online media to keep your creative furnace stoked with the information you need to make your artistry burn bright.

Ted Greenwald

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Rapid 3D #4

Tasteless Maya

I find the ad for Alias|Wavefront Maya (July 1999) to be objectionable. Perhaps it would appeal to an adolescent male, but it smacks of sexism to this mature female artist. I look forward to your magazine each month and was disappointed in your acceptance of this type advertising.

Linda D. Pendleton
Manager, computer graphics and animation
King Schools Inc.

Bones for Life

Thanks very much for your extensive review of Life Forms Studio (by Paul Davies, June 1999). We appreciated your constructive comments so much that we've taken the opportunity to integrate the majority of them into our newest release, Life Forms Studio 3.5.

Specifically, Life Forms Studio 3.5 offers support for LightWave 3D bones—including motion retargeting—plus numerous interface advancements. For a complete overview of Life Forms Studio 3.5, please visit the Credo Interactive web site at www.credo-interactive.com.

Ken Bryson
Credo Interactive

We want you

What do you think of *3D*? Post your letters and comments to the *3D* web site at www.3d-design.com, mail them to us at: *3D* Letters, 525 Market St., Suite 500, San Francisco, CA 94105, or e-mail 3d@mfi.com.

Please include your full name, city, and state. We reserve the right to edit letters for clarity.

Visualized Well?

I just wanted to pass on my positive comments about Joe Greco's recent article about architectural presentations ("Raise the Roof," July 1999). The majority of our customers use 3D Studio VIZ or MAX along with our real-time 3D modeling and simulation tools. Greco did a good job explaining the benefits of using these programs for architectural presentations.

Jon Zucker
Market manager, urban simulation
Multigen-Paradigm Inc.
San Jose, CA

The reason for architects' slow acceptance of 3D is not the learning curve involved, but because most 3D software is creatively limiting. Indeed, 3D Studio VIZ is an intuitive piece of software, but as an architect, I like to reserve it mainly for rendering and animating walkthroughs.

I find auto·des·sys form·Z much more valuable for creating designs. It combines solid and surface modeling; you can build via many different analogies, such as molding clay, stacking a deck of cards, or chiseling stone. Another advantage is that form·Z works using a system of operand and derivative objects. Just draw a bunch of lines, 2D shapes, and 3D objects, then snap, extrude, revolve, sweep, skin, mesh, split, fuse, and mold them any way you see fit.

Something else that's easier in form·Z is matching a model view to a photograph view. The article states how easy VIZ makes it, then describes the tedious process. form·Z contains a tool especially for that purpose—the Match View tool. Import your photo, turn on Match View, and manually stretch the computer perspective to match the photograph. VIZ has the advantage of third-party plug-ins, but besides tree libraries, these plug-ins mostly benefit the animation side of VIZ. As far as meeting all the needs of architects, form·Z has all other tools beat hands down.

Craig Elliott Brown
via the Internet

Desktop Digitizer

I read with interest the article, "From Concept to Reality" (by Anshuman Razdan, July 1999). Roland also makes a desktop 3D digitizer and a desktop 3D prototyping machine. The combined cost of both machines is under $2,000, considerably less than the $60,000 price listed in the article's sidebar on p. 30. The output area of each is 6 x 4 x 1.53 inches. I realize that this is smaller than the typical machine, but the digitizer is accurate within .002 inches. The prototyping machine accepts files from CAD and animation programs. We also have output machines with larger work areas of 4-11/16 x 3-7/8 x 4-11/16 inches ($7,995) and 9-13/16 x 5-7/8 x 5 7/8 inches ($18,995). Larger format machines are coming soon, including one that has interchangeable heads for both digitizing and prototyping. Compatibility with the .stl format is also coming soon.

Juli Korneychuk
Marketing supervisor
Roland DGA Corp.

BY CHRIS TOME

PDI Goes *Fishing*

We also mourn Paul Montgomery, look at new chips, speed up the Alpha, and follow the trail of 3D lawsuits.

Fishing **is a short** animated piece produced by Pacific Data Images (PDI) to show off its latest technological and artistic innovations. Scheduled to premiere at the annual SIGGRAPH Electronic Theater on Monday, August 9, 1999, *Fishing* was produced using PDI's proprietary software to achieve a unique hand-painted watercolor look.

The Academy Award-winning fluid dynamics system known as FLU, originally developed by PDI's Nick Foster for *Antz*, was used to generate a "tsunami of fish." Combining FLU with thousands of fish models and the watercolor process, the artists and animators at PDI created a tidal wave of murderous wiggling fish.

Director David Gainey kept the animation, character design, and final look as loose and fluid as possible. The motion animation is broad, with extreme holds and poses that accentuate the Fisherman character's features: big hands, big feet, and heavy stomach. The watercolor CG process is adjusted throughout the film to ensure that subtlety is not lost in the abstract paint style. In addition, the colors are animated to reflect the changing time in day as well as the mood of the Fisherman. Monet's Cathedral paintings inspired the changes in the color palette as the day progresses from dawn to dusk.

In Memorium

It is with great sadness that we report the passing of Paul Montgomery, co-CEO of Play, Inc., on June 19, 1999. Play, well known in the consumer market for its Snappy digital camera, developed the groundbreaking Trinity video studio-in-a-box and acquired the highly regarded Electric Image 3D modeling/animation/rendering software.

Montgomery made headlines in early June by publishing a full-page advertisement in an entertainment trade newspaper accusing George Lucas of breaking an agreement to publicize Industrial Light & Magic's use of Electric Image in the making of *Star Wars Episode 1: The Phantom Menace* in return for custom programming services.

The subsequent uproar within the 3D and cinematic effects communities threw a spotlight on digital graphics tools beyond Electric Image itself—Puffin Designs Commotion, Adobe Photoshop and After Effects, and auto·des·sys form·Z are also confirmed to have been used in the making of *The Phantom Menace*.

Montgomery was instrumental in building NewTek and developing the Video Toaster. He left to found Play in 1994. The digital graphics industry as a whole will be poorer for having lost Montgomery's bold spirit.

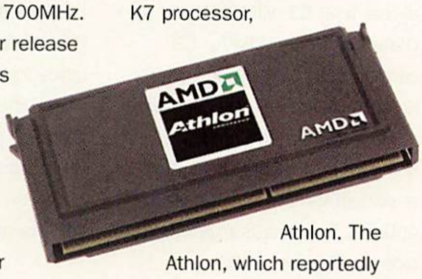
Stills from PDI's new watercolor-style animated short, *Fishing*.

Intel Slides, AMD Glides

In a surprise move, Intel pushed back the release date of its latest Pentium III chip, code named Coppermine. These Pentium III chips, based on a .18-micron copper process, were expected to reach speeds of up to 700MHz. Originally scheduled for release in September, the chips aren't expected to be available until Q4 1999 or possibly later. Consequently, many PCs will not ship with the new processor until Q1 2000. Intel is still expected to release a 600MHz Pentium III based on the older .25-micron technology to coincide with SIGGRAPH in mid-August.

The main reason for the delay, according to Intel, was unacceptably low yields on the 600MHz version. This came as unwelcome news to workstation vendors planning to show their next-generation systems at SIGGRAPH.

Although it's bad news for Intel, the delay could be an opportunity for AMD to gain a greater share of the high-end graphics market for its K7 processor,



Athlon. The Athlon, which reportedly outperforms current Pentium IIIs, will be released during the summer in speeds of 500MHz, 550MHz, and 600MHz. This gives AMD an easy two- to three-month head start. If the K7's floating-point capability performs as advertised, AMD's next-gen chip could put a dent

in Intel's high-end chip monopoly. Intel has pushed back the release of the mobile PIII as well, giving AMD an added advantage in the laptop market with its K6-III chipset running at 400MHz.

But AMD is not without worries of its own. As we went to press, the company announced Q2 losses much greater than expected—roughly $200 million in losses on sales of less than $600 million.

S3 Cashes in Chips for Diamonds

Chip vendor S3 has announced an agreement to purchase Diamond Multimedia in a deal worth $180 million. After falling behind in the graphics market, S3 recently signed on a number of major new customers for its Savage4 graphics chip, including Compaq, IBM, Packard-Bell-NEC, and Micron. Diamond Multimedia, on the other hand, has been a market leader in graphics cards and recently successfully defended its RIO portable MP3 audio player against a lawsuit brought on by the Recording Industry of America.

Under the terms of the agreement, S3 will purchase Diamond Multimedia for S3 common stock. Diamond shareholders will receive 0.52 shares of S3 common stock for each share of Diamond stock. S3 will assume Diamond's outstanding options. The deal is expected to close in October 1999.

Spatial Buys Sven

Also fresh from the land of corporate mergers was the announcement that Spatial Technologies, a developer of open component 3D modeling technologies, will acquire Sven Technologies, developer of Surface Suite Pro. Sven will provide Spatial with technology and expertise that enhance the visualization and rendering capabilities of its entire family of 3D software products, along with providing core technology for Spatial's web-based interoperability and services strategy. Sven's rendering optimization technologies are well suited to rendering realistic 3D models in bandwidth- and processing-constrained environments such as the Internet and corporate networks. The deal is expected to be valued between $850,000 and $1,250,000.

Trade Secrets

Real3D, a manufacturer of realtime 3D graphics technologies, is suing ATI Technologies, a leader in the 3D chip market, for patent infringement and misappropriation of trade secrets. Along with accusations of violating two patents held by Real3D, the suit alleges that ATI and others conspired to misappropriate trade secrets and know-how, having acquired this information through improperly soliciting and hiring Real3D engineers. Real3D is requesting that the Orlando, Florida, federal district court issue injunctions against ATI to cease the sale of infringing graphics products and to cease and desist from the unauthorized use of Real3D's trade secrets and know-how.

Media 100 Gets Cleaner

In May, video editing system vendor Media 100 signed an agreement to purchase Terran Interactive, developer of the video file format version and compression software, Media Cleaner Pro. The news was followed by reports that Media 100's sales increased by 30 percent in Q2 1999. Credit for the increase has been attributed to sales of Finish, a Windows NT-based video editing solution, and version 5.5 of Media 100's software for the Mac platform.

Copyright Infringement

3dfx has filed suit against Creative Labs and Creative Technology for copyright infringement and breach of contract. The chip vendor charges that Creative infringed 3dfx copyrights by incorporating 3dfx Glide source code into Unified, Creative's recently announced technology designed to run Glide-only software titles on Creative TNT and TNT2 graphics cards. Developed by 3dfx, Glide is a graphics API that runs on 3dfx accelerators. More than 200 titles currently use Glide, with 100 more in development.

Alpha's Gig

At PCExpo in June, Alpha Processor Inc. (API) debuted the first-ever processor running at 1000MHz (1GHz) at room temperature without the need for special cooling subsystems. The company also announced the Alpha 750MHz 21264, the world's fastest commercially available 64-bit processor.

The Chat Came Back

The industry seems to be gearing up for Round 2 of the 3D chat sweepstakes. Amid a gathering wave of new tools and technologies for delivering 3D online, content developer Worlds Inc. inked a deal with Freeserve Ltd., a UK ISP, to provide interactive 3D content. Worlds Inc. will develop a slimmed-down 7MB world that includes multi-user graphical environments where Freeserve customers can meet and share information. Freeserve plans to expand the site to include e-commerce in the near future.

Urban Sim

The City of Sunnyvale, California, signed on 3D sim pioneer MultiGen-Paradigm to help planners evaluate proposed developments before they're approved for construction. Using the company's authoring and viewing tools, MultiGen-Paradigm modeled eight city blocks including a shopping center, train station, historic district, and undeveloped area, and gave users the option to fly, walk, or be guided through it. The simulation, which took nearly two months to build, was based on digitized parcel maps, aerial photos, and site plans; digital photos were used as textures

Virtual Flameout

What would you do if you were piloting a jet fighter and the engine began to flame out? U.S. Air Force pilots will be able to answer this question without leaving the ground, thanks to a next-gen F-16 fighter simulator powered by SGI computers. The new simulator, which will provide a briefing-to-debriefing networked VR experience in real time, will be based on SGI Onyx2, Octane, 320, and 540 workstations and Origin 2000 servers.

Chris Tome is technical editor for *3D* magazine. Email him at ctome@mfi.com.

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BY CHRIS TOME

SGI Quad Xeon

Expanding their line of NT-based Visual Workstations, SGI is shipping the Xeon-based SGI 540. Starting at $6,500 with one processor, the SGI 540 holds up to four 550MHz Pentium III Xeons and up to 2GB of ECC SDRAM. The system comes standard with six PCI slots, two internal drive bays, and a 9.1GB Ultra SCSI-2 disk, and optional drives up to 54GB each. Standard connectivity includes IEEE 1394 (a.k.a. FireWire), 10/100 Base-T Ethernet, S-video, composite video, audio, and USB.

RAPID 3D NO. 151

3D Authoring

EON Reality offers a suite of tools for creating real-time interactive 3D simulations that can be delivered either on disc or on the web for training, sales, urban planning, and other sim applications. Running on Windows 95/98/NT, the EON 2.5 suite includes EON Studio (for authoring simulations), EON Immersive (which supports high-end multichannel display environments), and EON SDK (an integrated programming environment that plugs into Microsoft Visual C++). Newly released Service Pack 1 enhances quality and productivity during the development process by providing improved OpenGL texturing performance, support for additional Windows functions, more efficient prototyping features, and a more responsive GUI.

RAPID 3D NO. 152

Paint Power

Deep Paint 3D ($795) from Right Hemisphere is a real-time 3D paint program that lets you paint with airbrush, oil paint, watercolors, color and charcoal pencils, felt pens, chalk, pastels, gouache, acrylics, texture and image spray paints, and more. You can paint multiple channels simultaneously, including color, bump, shininess, opacity, and glow. Deep Paint is compatible with Wacom's Intuous tablets. It can also include complex 3D selection sets and masks that can be bitmap- or geometry-based and can be combined, Booleaned, saved, and retrieved. New tools can be created and saved on a network server and shared to multiple clients to maintain a consistent look and feel for large projects.

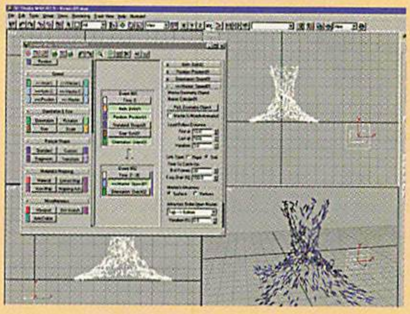
RAPID 3D NO. 153

Plug in to MAX

Because the world is a dirty place, Digimation offers QuickDirt ($245), a plug-in for Discreet 3D Studio MAX and VIZ. QuickDirt, which adds dirt, rust, mud, and other topology-dependent texture effects to mesh objects, works in real time. Interactive viewport feedback makes it easy to apply the effect precisely.

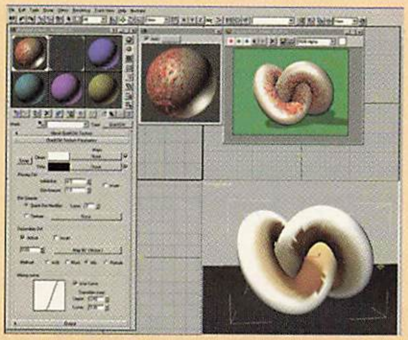
RAPID 3D NO. 154

Digimation also offers Particle Studio ($595), a particle system for MAX made up of three plug-ins: Particle Studio, Particle Studio Helper, and Particle Studio Snapshot Utility. Particle Studio lets you create particles in an event-driven environment; at any time over a particle system's life, you can define a new event – say, a space warp – and a new set of parameters for that event.



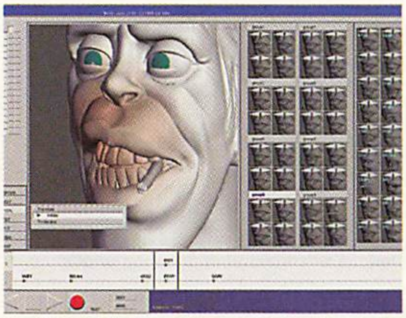
RAPID 3D NO. 155

Meanwhile, Trinity Animation throws MatterWaves 1.0 ($295) into the MAX particle plug-in ring. MatterWaves is a material-mapped particle system that can work in conjunction with other particle systems, such as FreePyro and PyroCluster (both available from Cebas). Map- and gradient-based object fragmentation makes it easier to create sequential explosions of large objects. In addition, interparticle dynamics gives particles the ability to attract each other, change speed as they fly apart, strike, and deflect each other, and so on. A metaparticle system is included for organic blobby effects.



RAPID 3D NO. 156

About Face



➤ **LightWave and 3D Studio MAX** users looking to do natural-looking facial animation may get a boost from LipService 1.0 ($299) by Joseph Alter. LipService provides clay-like sculpting tools for creating up to 50 poses, then interpolates target-to-target animations using a spline motion path for each vertex. Alternatively, animations can be performed in real time using a mouse. Delta morph animations can be layered over keyframed animations for eye blinks, smiles, frowns, and the like. In addition, the program lets you scrub through a .wav file frame by frame for tight audio sync. Plug-ins are provided to import LipService's output into LightWave and MAX.

RAPID 3D NO. 157

NewTek's New Aura

➤ **NewTek has updated** Aura ($999), their video paint, layering, and compositing tool, to version 2.0. The new version extends the program's paint and compositing capabilities with a new hi-res video paint engine and an expanded lineup of features. The new chromakeyer offers blue spill enhancements, and the enhanced keyframer provides built-in motion tracking. Real-time features such as video stencils, gradients, textures, and unlimited layers make Aura 2.0 worth a closer look.

RAPID 3D NO. 158

Photoshop Facelift

➤ **Adobe Systems has released** Photoshop 5.5, an incremental update to its image-editing software that includes new features for web- and print-based image manipulation. The Save For Web feature lets you visually choose the best compression-to-image-quality ratio for a given image. Other new features include the Background Eraser and the Extract Image command, which simplifies the process of compositing images onto other backgrounds. Registered Photoshop users can upgrade to 5.5 for $129.

RAPID 3D NO. 159

Immersive Digitizing

➤ **Immersion Corp. recently released** Inscribe 3.0, a software package that works with Immersion's MicroScribe line of 3D digitizers. Inscribe allows 3D artists to digitize points, curves, and surfaces directly into most Windows 98/NT graphics and CAD packages. New functions that enhance accuracy and improve digitizing speed include auto-plot, which lets you trace an object contour and create evenly spaced points; mapping, which lets you digitize a very large object in several sections; and scan planes, which let you create 2D cross sections of a physical 3D object. Inscribe 3.0 is free to all MicroScribe owners.

RAPID 3D NO. 160

Going to the Cinema

➤ **At SIGGRAPH 99, Maxon** will unveil Cinema 4D XL 6.0 ($2,195, $495 upgrade), a major upgrade of their flagship 3D animation application for Windows 95/98/NT, MacOS, and BeOS (due Q4 1999). New features include more than 50 lighting and illumination modes, radiosity-like area shadows, and volumetric noise. Modeling has been enhanced with the addition of metaballs, metasplines, and hyperNURBS, a new cage modeling feature. Animation controls now include point-level animation, multiple selections in the timeline, animation mixing, and auto keyframing.

A new 3D paint program (code named Marvin) will come with Cinema 4D XL 6.0 and be available separately. The program lets you paint on any object material channel (opacity, bump, transparency, reflection, and so on) in real time. Brushes and other tools are responsive to input from Wacom's Intuos line of pressure-sensitive tablets, including pressure, angle, and direction.

Another new addition to the package is Cinema 4D Net, an HTML-based network rendering tool that lets you share rendering jobs across an unlimited number of computers, regardless of platform. Cinema 4D Net's network protocol is TCP/IP, making it possible to control distributed rendering via a web browser.

RAPID 3D NO. 161

Rapid 3D #8

Body by Poser 4. Soul by Designer.

Poser 4 the Premier 3D Character Animation and Figure Design Tool

Poser 4 sets your creative soul free with powerful, yet easy to master character animation tools for digital artists and animators.

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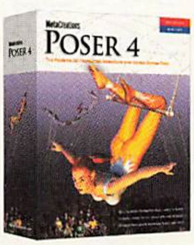

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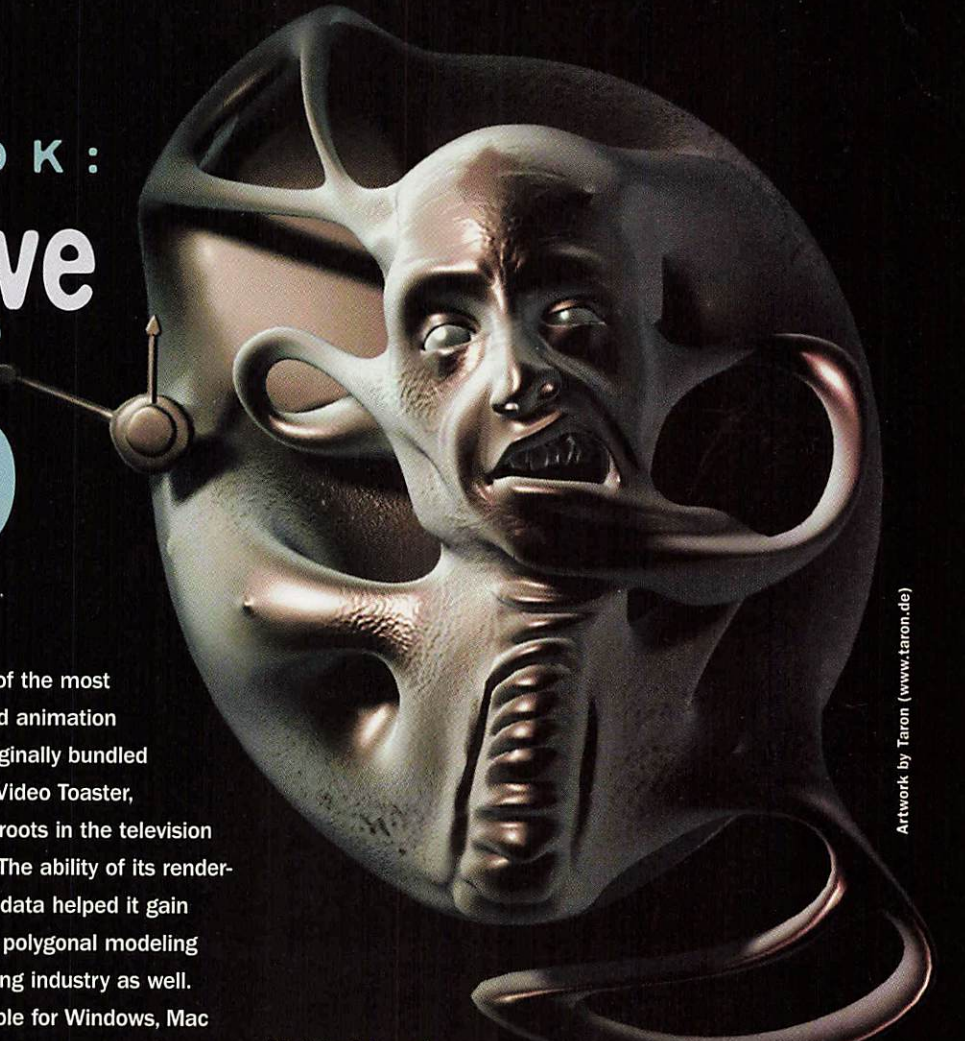
Rapid 3D #9

BY ACE MILES

FIRSTLOOK: LightWave 6



Artwork by Taron (www.taron.de)

NewTek LightWave 3D is one of the most widely used 3D modeling and animation packages on the market. Originally bundled with NewTek's Amiga-based Video Toaster, LightWave developed strong roots in the television industry as a 3D broadcast video tool. The ability of its rendering engine to handle large amounts of data helped it gain prominence in the film market, and its polygonal modeling tools have made it popular in the gaming industry as well. LightWave is also multiplatform, available for Windows, Mac OS, DEC Alpha, IRIX, and Sun Solaris.

The release of LightWave 5.5 in 1997 represented a major upgrade over v. 5.0. It included an improved interface and a slew of new tools and plug-ins. Yet it was just a ".5" upgrade. Last year, 5.6 was released as a free upgrade and, again, was more than just a little patch. It was full of shaders and plug-ins, most notably the HyperVoxels advanced rendering plug-in.

According to NewTek, the reasoning behind these major upgrades with minor changes to version number is that the company has had its sites set on 6.0 for quite some time and has planned for it to be a considerable leap in functionality over previous versions.

LightWave 6.0 (dubbed L[6]) should be officially unveiled by the time this issue prints. Due to the fact that the software is still in beta as of the time of this writing, it's not so much a review as it is a first look at the new version. Many features are not fully active and some haven't been installed yet. Take the interface, for example. It's likely that some updates will occur by the time L[6] is released, but for now, it closely resembles the 5.6 interface. However, aside from the features that aren't ready for prime time, there is a ton of new stuff I can tell you about.

Modeler & Layout

LightWave's two-program format still exists, but the connection between Modeler and Layout is much stronger. This update appeases both sides of the LightWave user base, long divided in their opinions about the software consisting of two separate programs. Some love the fact Modeler and Layout are separate, while others would like them to be one interface. To most users, this feature will represent the best of both worlds, in a sort of "you got your chocolate in my peanut butter" sense.

If you edit an object in Modeler, it's automatically updated in Layout. Your modeling environment remains uncluttered, and you no longer have to go through the steps of updating your objects or worry about losing data by forgetting where you saved it. The need for LightWave's "get" and "put" buttons, which allowed you to move models between environments, has been eliminated. Although these buttons made the two-program format a little easier to navigate, it was easy to forget to save objects while "getting and putting."

Another feature strengthening the connection between Modeler and Layout is the HUB. The HUB's primary function is to store all scene file data. For example, while working in a 2D

paint program, you can access texture maps or background images from your LightWave scenes via the HUB. Another possibility is painting on LightWave objects from within a 3D paint program, producing immediate updates in your LightWave scene. The HUB lets you switch environments without having to load and save data to share. It also provides auto-saving functionality as well as making the data crash-proof; if LightWave takes a dive, the HUB remembers where you left off and sets back up again.

Configurability LightWave has always been known for its ease of use and intuitive interface, although previous versions have had room for improvement. In some cases, panels would nearly fill the screen, and they were extremely modal. NewTek addressed this issue in 5.5 by adding user-definable keyboard shortcuts in Modeler and giving us a non-modal statistics window. But we hadn't seen nothin' yet.

L[6] blows LightWave's previous user configuration out of the water. Not only can you configure hot keys in Modeler and Layout, you can customize menu bars as well (Figure 1). A simple menu-configuration panel lets you add or remove main menu tabs across the top of the screen. These tabs can be named or renamed anything you like, allowing you to organize your tool sets as you please. Tools can be rearranged and organized by dragging and dropping within the menu configuration window, and if you have a favorite tool, you can add it to each menu. You can also customize your own pop-up menus for the left, right, and middle mouse buttons.

There are a dozen different options for the viewports in both interfaces. In any of Modeler's views, you can choose between Flat or Smooth Shaded, Wireframe and Sketch, or one of three new options: Wireframe Shaded mode, which draws the wire mesh on top of shaded geometry; Textured Solid mode, which allows you to see textures in Modeler; and Weight Shaded mode (more on this later).

All of Modeler's views can have independent zoom, center, background color, and visibility options. You can have a full 24-bit backdrop image in each viewport displayed in resolutions from 128 to 1,024 pixels. There's also a pixel-blending option available in both Modeler and Layout that, when using

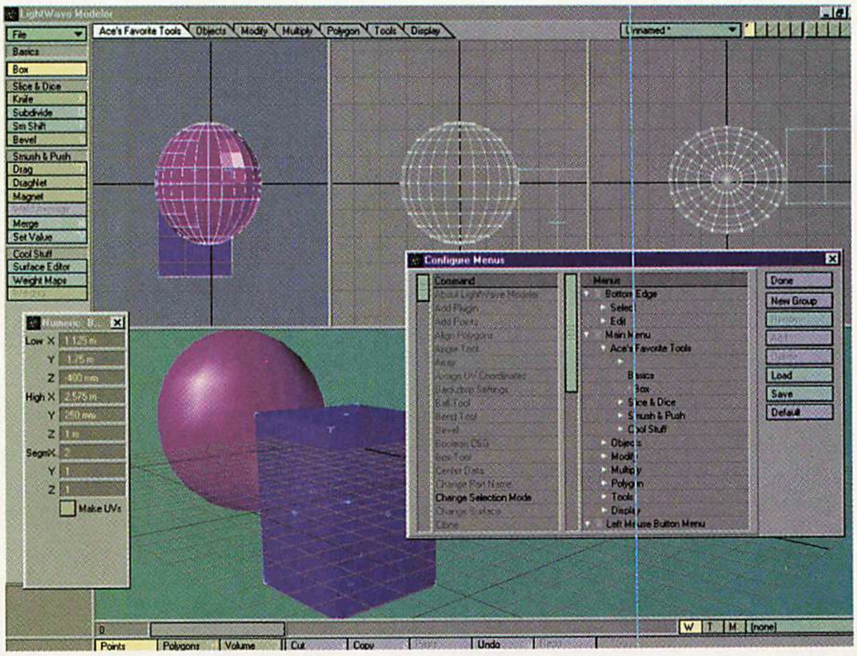


FIGURE 1. The LightWave 6.0 interface is fully customizable.

a lower resolution, helps to display a less pixelated image.

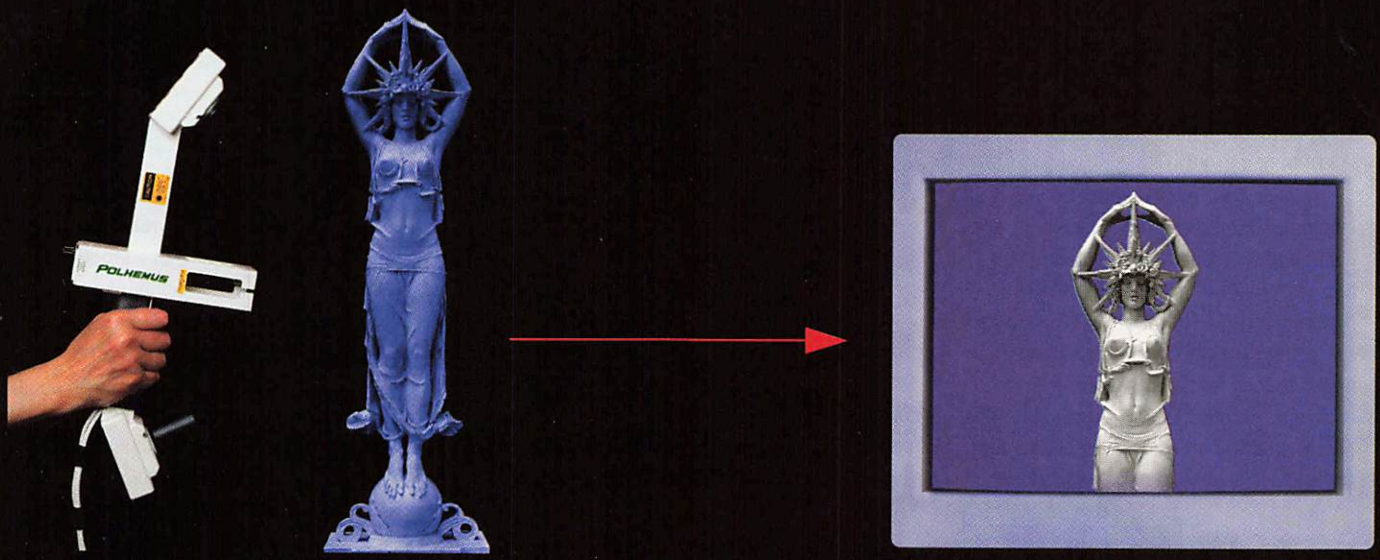
Modeling viewports can be individually configured to display any of the view types, which range from orthographic to perspective to UV texture mode. Also, the tool bar can be moved from the left to the right side of the screen, and both Layout and Modeler have a new field called Tool Tips that gives a brief description of tools and items as your cursor passes over them.

Modeling & Surfacing Although LightWave's Modeler has always been a strong polygonal modeling tool, it lacked features such as the ability to model in a perspective view and the often-requested interactive bevel. L[6] addresses these issues, taking interactivity to a new level. Everything from Lathe and Mirror to the Box tool has become interactive. To perform a lathe, you click and drag in the axis where you'd like the lathe, and it immediately begins to sweep the geometry. With the tool still active, you can continually change the lathe center by clicking and dragging, and the geometry will update in real time.

New interactive tools include Symmetry and Paste. Symmetry mode allows you to use tools such as stretch or rotate on one half of the object, which will affect the identical geometry on the other half of the mesh. This is especially useful when modeling bilaterally symmetrical objects such as characters and heads. The Paste tool lets you paste a copy of previously referenced geometry wherever you've placed your cursor with a click of the mouse, perfect for rapidly populating terrain with trees or other surplus items. You can also alter the size of each copy with a modifier key. Both of these tools offer great potential for saving time.

Another excellent update to Modeler is direct access to the Surface Editor, which has undergone some major improvements. One new feature (which is already included in most 3D apps) is UV mapping, considered long-overdue by many LightWave users, particularly gamers. Initially, the process for applying the map and assigning UV coordinates seemed tedious, but after digging a little deeper, I realized that the ability to use Modeler's tool set to manipulate the UV coordinate points more than made up for the involved set up.

After assigning UV coordinates, a map must be named for the polys being textured. Next, one of the appropriate viewports is set to "UV Texture" and the texture is loaded and placed in the backdrop of that view. The texture is then applied to the surface in either a planar, cylindrical, or spherical fashion, after which the projection can be changed to UV and the named UV map applied. Any points can be modified in the UV Texture port in Modeler, and the texture on the object in the other views updates in real time. The ability to use almost any of the modeling tools to manipulate the UV map is fantastic and NewTek plans to



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Rapid 3D #10

streamline the multistep process for assigning UV maps before L[6] is released.

Another new Surface Editor feature is infinite layers of projection, procedural, gradient, and UV maps. The layers can feed into each other for texture blending and manipulation. All surfaces can be animated, and a translucency channel has been added that can be used, for example, to texture a thin object without making it transparent. Imagine a bug crawling across the backside of a leaf—the bug's silhouette shows through, but not the bug itself. The leaf in this scenario is translucent.

Glossiness mapping and the ability to animate all surface attributes are additional features implemented due to user requests. Content management tools for surfaces have finally arrived in the form of filters (object, name, texture, shader, and preview). You can also include comments with your surfaces to keep notes on your images, which can help you navigate texture-heavy scenes.

The gradient shader that originated with HyperVoxels is now available for all surfaces (Figure 2). Options such as slope angle, bump, and previous layer can affect how the gradient is applied. Using gradients, you can easily recreate natural effects such as Fresnel reflection and diffuse transmission. There are also new blending modes for layers such as difference, alpha, and additive. The alpha-blending mode, for example, lets you use any image or procedural texture as an alpha channel between two other layers.

The number of layers in a surface can be overwhelming, and it would be nice to have another way to view the hierarchy of layers. There is a visual tree attached to the panel that allows layers to be disabled quickly to see their effect. This feature could use some added sophistication in future releases.

There are many new preview options. The sample sphere can update in real time, and you can set it up to show any channel's effect. You can also use objects other than a sphere or cube in the Surface Editor, and you can add anti-aliasing or layout as a background.

Vertex Maps UV maps are just one type of vertex map. L[6] also includes weight maps, which allow real-time subdivision surface modeling as well as the ability to control both point bias and the shape of your subdivision surface object without adding geometry. Essentially, subdivision surfaces let you work with a low poly "cage" object whose points control the underlying surface mesh.

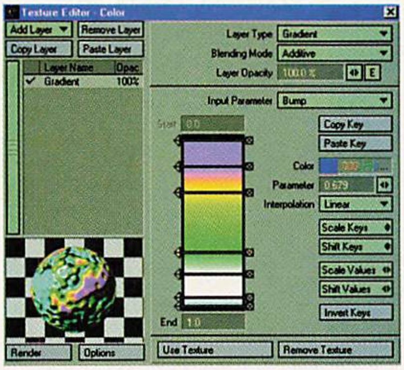

FIGURE 2. The gradient Texture Editor is one of many new additions to the Surface Editor.

To create weight maps, the new Weight tool is dragged over a point, which becomes softer or sharper depending on how you drag your mouse. The Weight Shaded mode allows you to see the effect of the Weight tool on the geometry (Figure 3). The area of shaded geometry surrounding the weighted point becomes either red-orange (sharper) or blue (softer). Point weighting is helpful for modeling complex and organic shapes, although in future versions, it would be nice to have the ability to select and weight edges.

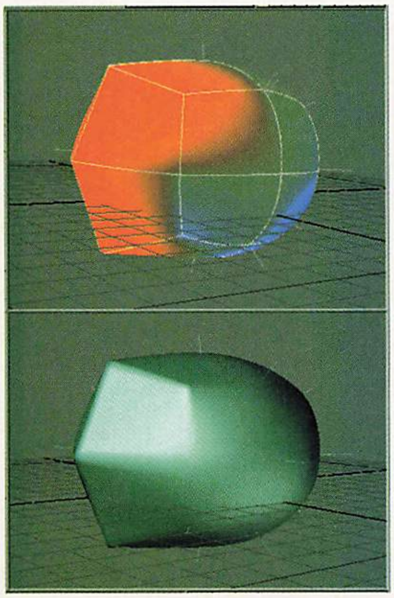

FIGURE 3. The upper image shows the Weight Shaded view, and the lower image shows the effect of weights on points in a smooth-shaded view.

Weight Shaded views can also be used to define how other deformational modeling tools (such as Magnet) and animation tools (such as Bones) will affect the points of an object. Weight Shaded mode helps you determine which points will be more or less influenced.

New Object Format To remove limitations, such as the number of points per object, and to add externally accessible UV maps, the object format was rebuilt from scratch. This gave NewTek the opportunity to get really creative with new features, such as Intelligentities. These "smart objects" can carry extra data in the form of Skelegons, Endomorphs, and MultiMeshes.

Skelegons are bone polygons that reside in an object instead of the scene file. They can be inserted into objects during the modeling process and are automatically translated into bones for animation. This lets you modify the surface polygons (with modeling tools such as Stretch and Magnet) as well as the skeleton. In past versions of LightWave, each character's bones had to be applied and saved in a "set-up" scene, and you'd "load from scene" to animate them together in a different scene. Having the skeleton embedded into the object file simplifies asset management, and being able to manipulate the skeleton simultaneously with the overlaying geometry is a tremendous time saver.

Endomorphs are data subsets stored in an object that make that object aware of different states. A character's head, for example, might include a smile state, a frown state, and an entire set of phoneme states in the base model (phonemes are the basic mouth shapes that make up speech). The states can then be accessed during animation. An object's states can be animated individually or blended to create unique combinations, eliminating the need to manage the traditionally cumbersome amounts of morph targets. It also allows you to return to the base model to make topographical changes, such as adding geometry or subdividing the surface while maintaining the various states. This approach would be extremely difficult using morph targets. Although the idea of Endomorphs is not new (Alias|Wavefront Maya,

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Rapid 3D #11

Nichimen Mirai, and others have comparable features), it is a welcome one, and should make character animation in LightWave much easier.

MultiMeshes are objects with multiple layers of geometry that can be individually manipulated during animation. Similar to Adobe Photoshop's image layers, each object layer can be edited and manipulated independently of the others. Each layer or part of the MultiMesh can have its own separate pivot point as well. For example, a car and its various parts can be built as a single object and still allow the wheels to rotate independently or the doors to open while the car is moving.

Combining these elements into a single Intelligentity is when it gets fun. Imagine a character that contains Endomorphs for the hand positions and facial expressions, a series of Skelegons to define the character's skeletal structure for simple animation and scaling of the skeleton, and a MultiMesh that includes elements such as the eyes, teeth, and tongue. Each of these elements could have its own rotational axis and be manipulated separately from the body, even though it's all part of the same object file. The tongue could even have its own set of Endomorphs attached.

New & Improved Animation Tools In past versions of LightWave, the animation tool set was one of the weakest links. L[6] has addressed many previous shortcomings with features such as vertex grouping for bone assignments and bones and morph targets embedded in the object file.

In addition to the new animation tools, NewTek has made some major improvements to the existing tool set, starting with separate channels for animation. Previously, you needed many null or dummy objects to control an object's individual animation channels through cumbersome hierarchies.

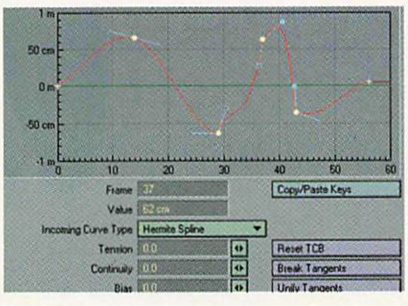

FIGURE 4. L[6] offers more control, such as the ability to break tangents and use Hermite and Bezier spline types.

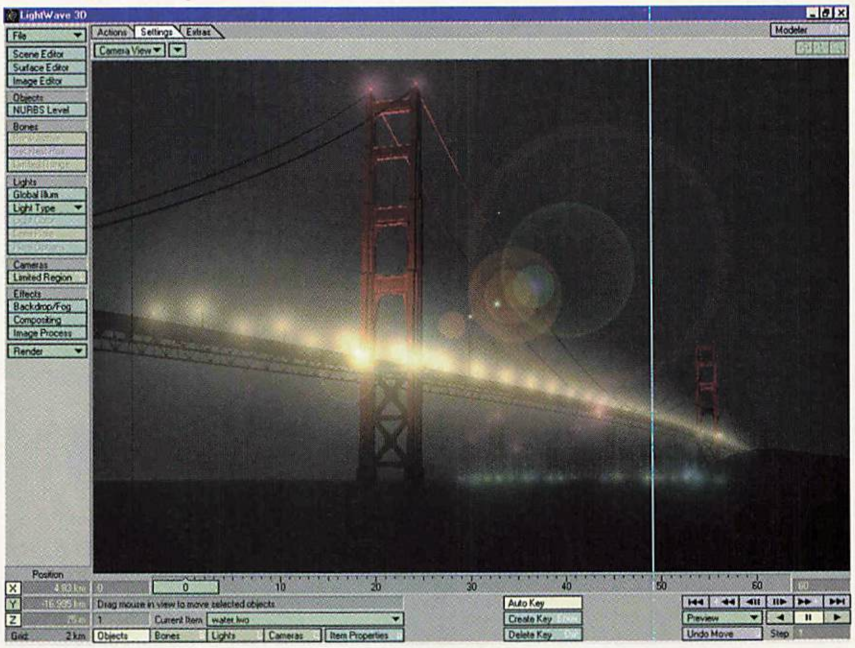

FIGURE 5. A sample scene in Layout using OpenGL fog and a few lens flares.

IK has been greatly improved with the addition of a hybrid solution. For example, hybrid IK lets you control the pitch of a leg with an IK goal while maintaining the ability to keyframe the motion of the heading or bank of the leg. You have the option to keep a goal within reach of its IK chain, making it easy to lock a chain to an item, such as a hand sticking on the rung of a ladder. You can globally enable or disable IK as well. In past versions, you had to enter each object's IK option panel to disable the IK chain, allowing you to move objects and set up or check rotation limits or the initial rotation value of joints. One particularly nice enhancement is that the rotation limits for IK, when left active, can become rotation limits for FK, which prevents you from bending a joint too far in the wrong direction.

Another improvement is the ability to animate all relevant scene attributes as well as some new curve controls in the Motion Editor. For example, the new select mouse function lets you select multiple keys and modify them using the shift key. Previously, motions were limited to TCB (tension, continuity, and bias) splines or linear transitions. L[6] includes a stepped transition, which holds the last key value and jumps to the next key's value. Hermite splines, though similar to TCB splines, allow for a much wider range of results and are edited by dragging points at the end of the tangent control. Bezier splines include handles for changing the angle of the tangent. This will affect only the curve coming into a key unless the subsequent key is also a Bezier, which will give you an outgoing handle on the right of the key. By default, the outgoing tangent is unified with the incoming; however, tangents can be split or reunified easily. I found the different curve types and multiple tangent types per curve very useful (Figure 4).

Interactivity & OpenGL Enhancements NewTek was one of the first companies to add lens flares to a 3D package, and now they're at it again. In L[6], you can see lens flares in real time in the camera's OpenGL view. I was impressed at how helpful it was to interactively set the nominal distance for my Fade With Distance setting and what it would look like with a central ring without having to constantly test render.

Setting up fog in Layout is also easier. There are two fog circles in the orthographic views—one for minimum distance to the camera and one for maximum. However, you may just decide to use the new OpenGL fog in the camera view only. Like lens flares, this fog allows you to see the effect of your fog from the camera view, making it far more interactive to set the fog parameters. (Figure 5 is an example of OpenGL fog and lens flares.)

One of the less useful, yet fun-to-play-with features is reflection mapping in real time. A simple toggle in the display settings will let you view spherical reflection maps in

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Rapid 3D #12

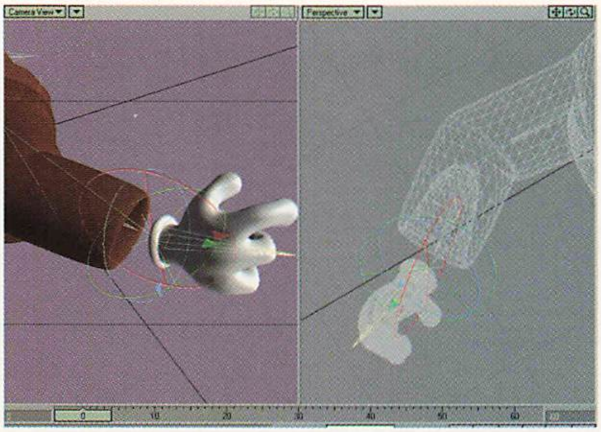


FIGURE 6. The new rotation discs are shown here as red, blue, and green circles. On the left, visible IK chains are shown as light blue lines moving up the arm, and the selected bone in the hand is visible through the OpenGL's "x-ray" view.

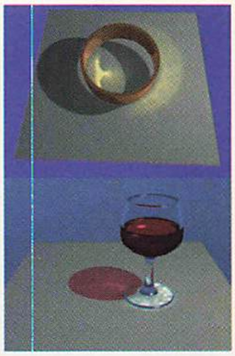


FIGURE 7. The caustics look good even with fairly low-quality settings for speed.

OpenGL. More useful items include tick marks and labels on the time slider as well as a frames per foot setting. Keyframes can exist before the zero key, allowing the time slider to access negative frames. Other handy items are backdrop colors in the camera view, the grid appearing in all views, grid antialiasing, the ability to edit directly in the numeric readout fields for the XYZ and HPB, and the ability to make wireframe previews using colored wireframes.

One of my favorite new OpenGL enhancements is the ability to see things such as pivot points, bones, nulls, and lights through solid objects. Similar to Maya's x-ray mode, objects appear ghosted yet visible, making it far easier to place bones in an object without having to change your display to a wireframe mode. This feature carries over to Modeler. When you select points and polys from the backside of a model in a solid-shaded view port, they are shown ghosted as long as they are behind other geometry, whether it's on the same object or not.

As far as visual enhancements go, I've saved the best for last: visible rotation discs and IK chains. These items are extremely helpful in the animation process. The rotation discs option shows red, green, and blue (heading, pitch, and bank) rings around the selected item's pivot point. There is an arrow to help show the related rotation value, and if you are using IK rotation limits, they will also be displayed on each ring. The visible IK chains option draws a solid line from the start of a chain to the goal. If a goal is allowed to be pulled away from its chain, it will be shown as a dotted line (Figure 6).

Apparently, NewTek put some serious effort into providing as much real-time feedback as possible. While some of L[6]'s new features may seem trivial, they can save a lot of time because fewer test renders are needed. These little productivity enhancements can really streamline LightWave's workflow.

Good Gets Better LightWave's rendering engine has always been highly acclaimed. Internally, LightWave rendered in 96-bit IEEE floating-point, using a clean dithering algorithm to reduce the final output to a 24- or 32-bit image. L[6] takes this to another level by allowing you to save in formats such as 64-bit TIFF or true 10-bit-per-channel Cineon (for both input and output). High bit depth is essential for high-end post-processing and film output.

The volumetric engine takes full advantage of LightWave's HyperVoxel technology, resulting in faster rendering of volumetric effects and making it easier for things like smoke and clouds to interact with scene elements such as raytraced reflections. Antialiasing and subpixel displacement rendering have been improved, and you can now animate with a low-poly subdivision surface object, view it at one level, and render it to a higher-resolution subdivision level.

Caustics and radiosity have both been added to LightWave's bag of rendering tricks. At the time of this writing, the radiosity was just being tested and was unavailable for review, but early tests look very promising. The caustics, however, were ready, and quite well implemented.

The two scenes NewTek supplied with the beta software are a good example of what caustics are capable of. One scene showed a gold ring on a flat surface, and the other showed a simple glass of wine on the same surface (Figure 7). The only differences were the settings of the objects' surfaces. The ring had the attributes of a reflective metal, and the glass and wine surfaces were transparent (the wine also used the color filter) with appropriate setting for the IOR (index of refraction).

The three caustics settings are intensity (a percentage that can be animated), accuracy, and softness. Increasing the accuracy increases the render time but can give amazing results. The softness setting can help achieve a wide range of results as well as allow for lower-accuracy settings. The settings for the ring were intensity 40 percent, accuracy 800, and softness 20. Render time for the scene at 320 x 240 with low enhanced anti-aliasing was 5 min., 18 sec. The wineglass was intensity 15 percent, accuracy 800, and softness 10. Render time for the scene at 320 x 240 with low enhanced anti-aliasing was 1 min., 45 sec. This included raytraced shadows, reflections, and refraction—not bad, considering it was rendered on an Intel Celeron 300MHz (not overclocked) with 128MB of RAM.

Catch the Wave In experimenting with L[6], I was pleasantly surprised at the range of features I got to play with. There were plenty of things I could've spent more time on, and plenty of new features that weren't yet available. Of the things that really stand out, however, modeling is so much more interactive, and the rebuilt object format is a dream come true. The new animation tools really enhance the existing set, and the ability to configure LightWave's interface is amazing.

Overall, L[6] looks pretty slick. There are still a few areas that need some polish, and some things I'd like to see added in future versions. Then again, the version I used was still not done cooking. Either way, L[6] will maintain its positioning as an industry standard, and it should be able to keep the rivals at bay for at least a while.

Ace Miles is program director and a senior instructor at 3D Exchange, an animation training facility in the San Francisco Bay Area. He has been using LightWave for more than 10 years, since it was still Videoscape on the Amiga. You can reach him at ace@3dexchange.com or visit www.3dexchange.com.


Practical Populations


Particle People


Cloned Creatures

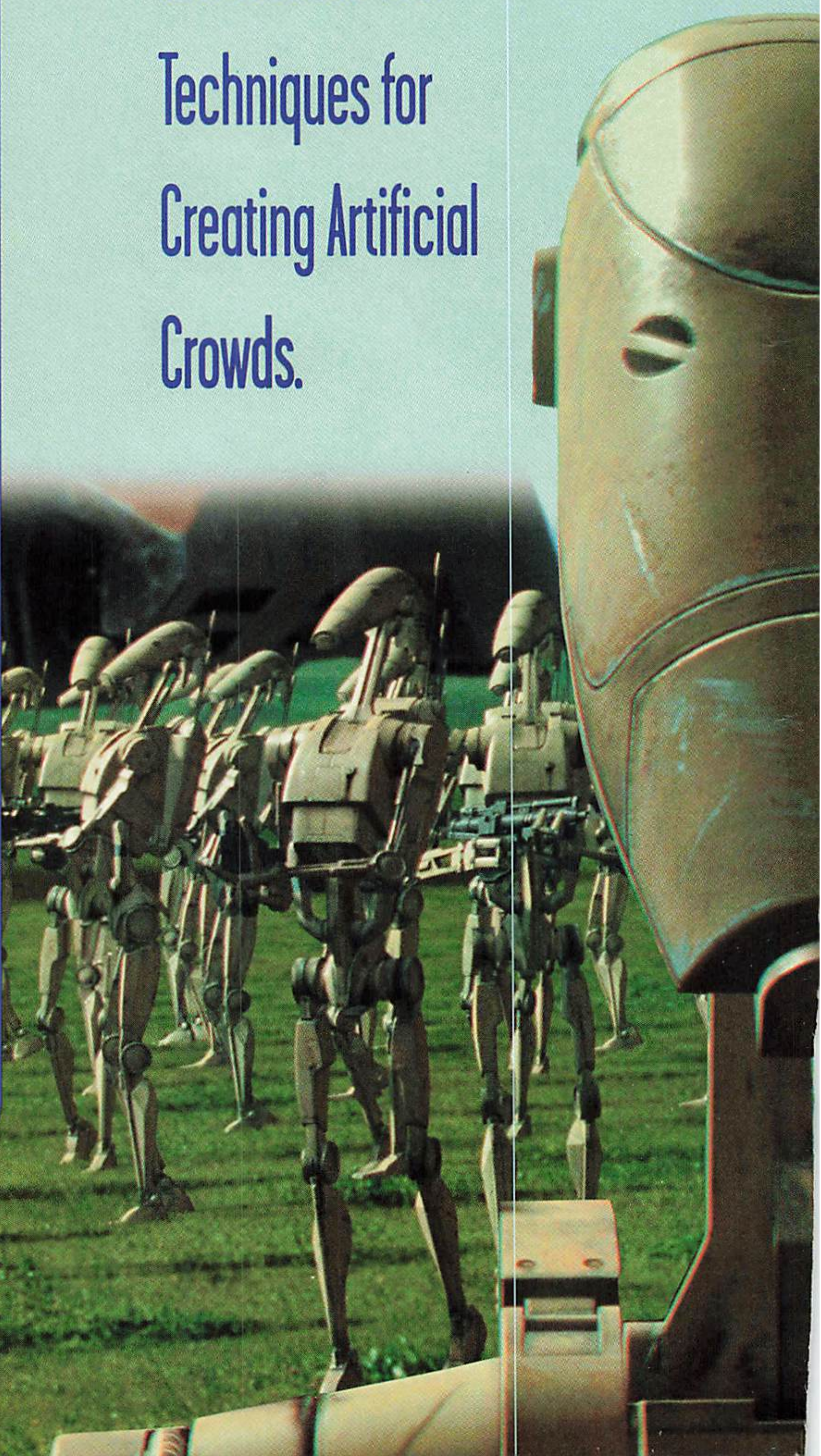

Committee of Cards


Duplicate Droids


Composite Crowds

A Cast

ILM Reveals Six Techniques for Creating Artificial Crowds.



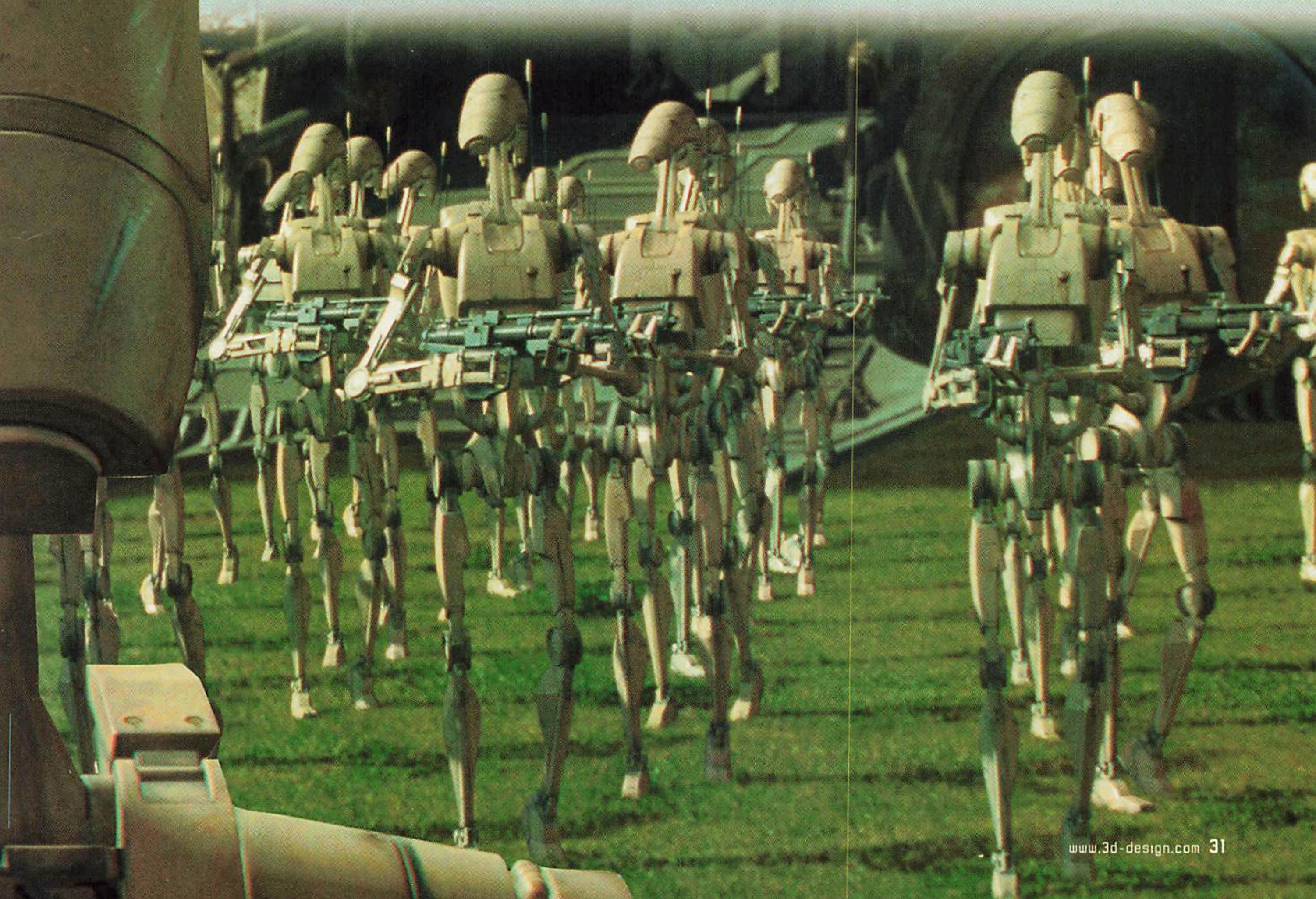
# of Thousands

On the day *Star Wars Episode One: The Phantom Menace* opened at movie theaters, many companies in California's Silicon Valley gave their employees the day off. Even banks and insurance companies, it seems, fell under George Lucas' spell.

One organization that might not have so been happy was the Screen Actors Guild. After all, it's not easy to get digital actors to pay their yearly dues. And make no mistake about it, *The Phantom Menace* is chock full of non-union thespians. The movie swarms with them—from humanoids to droids to alien swamp creatures.

Notwithstanding prominent CG life forms such as Jar Jar Binks and Boss Nass (the subject of last month's in-depth character study), most of the film's artificial actors appear in crowd scenes. Concocted by the ingenious team at Industrial Light & Magic (ILM), these sequences present an utterly convincing cast of thousands, even when the actual number of flesh-and-blood actors onscreen is no more than a dozen, and sometimes none at all.

How did they pull it off? In more ways than you can shake a light saber at. Some didn't even involve computers, such as the attentive audience of painted Q-Tips that fill the stadium bleachers during the pod race on the planet Tattooine. Digital technology did fill the stadium grounds and aisles, however, where a throng of animated human and alien figures was emitted by a Maya-based particle system that calculated their paths on the fly using artificial intelligence. Meanwhile, a herd of otherworldly animals stampedes through the Naboo jungle along fixed spline paths that were laid out and tweaked by hand. In the enormous spherical Senate chamber on the planet Coruscant, where the Trade Federation debates the fate of Naboo, preshot and prerendered delegates were projected onto an array of 3D cards. The climactic battle between the amphibious Gungans and the

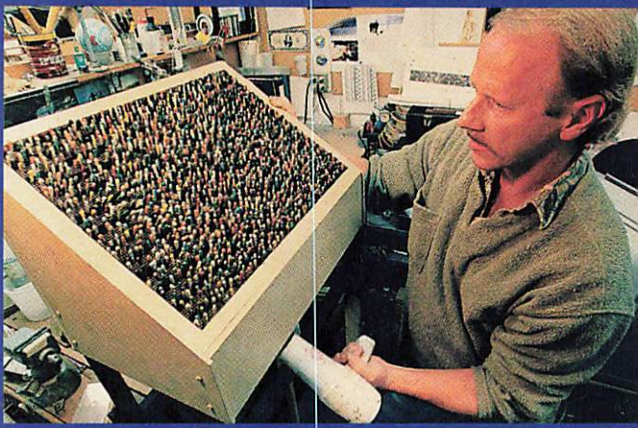


mechanical droid army involved an immense field of motion derived from a small number of mocap files. And, in what might be the simplest method conceptually—but a technical challenge nonetheless—the adoring crowd that lines the streets cheering the triumphant Gungan victory parade actually consisted of many small groups of live actors filmed and composited into positions determined using Softimage3D.

In the pages that follow, we'll look at each of these techniques in turn, delving into the thoughts that led to it, the tools used, and the obstacles overcome. The very scope of solutions ILM's artists and animators found to the common problem of how to make artificial crowds illustrates the no-holds-barred creativity they bring to their work. Their efforts were directed toward only one purpose: to make the shot work.

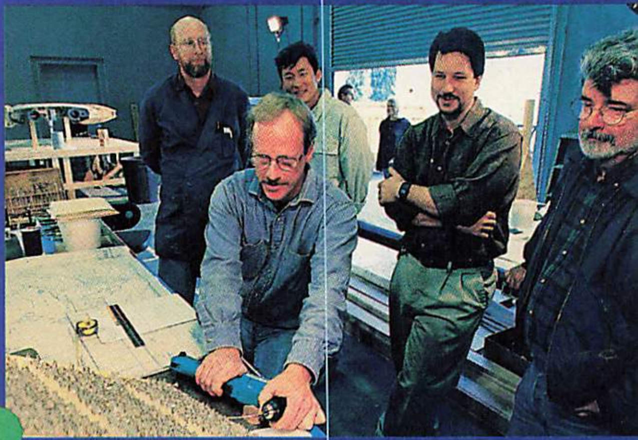
Practical Populations Sometimes all it takes to make the shot work is a bunch of bobbing Q-Tips. That was the conclusion reached by Michael Lynch, who has served as chief model maker at ILM for the past nine years, when he set out to populate the stadium where Anakin Skywalker bests the alien Sebulba in a hair-raising pod race. Lynch comes from the old school of practical effects. He might even be considered a dinosaur by today's high-tech standards, but one that, like the alligator, is far from extinct.

"As much as you can get in camera initially, the better," he points out while making



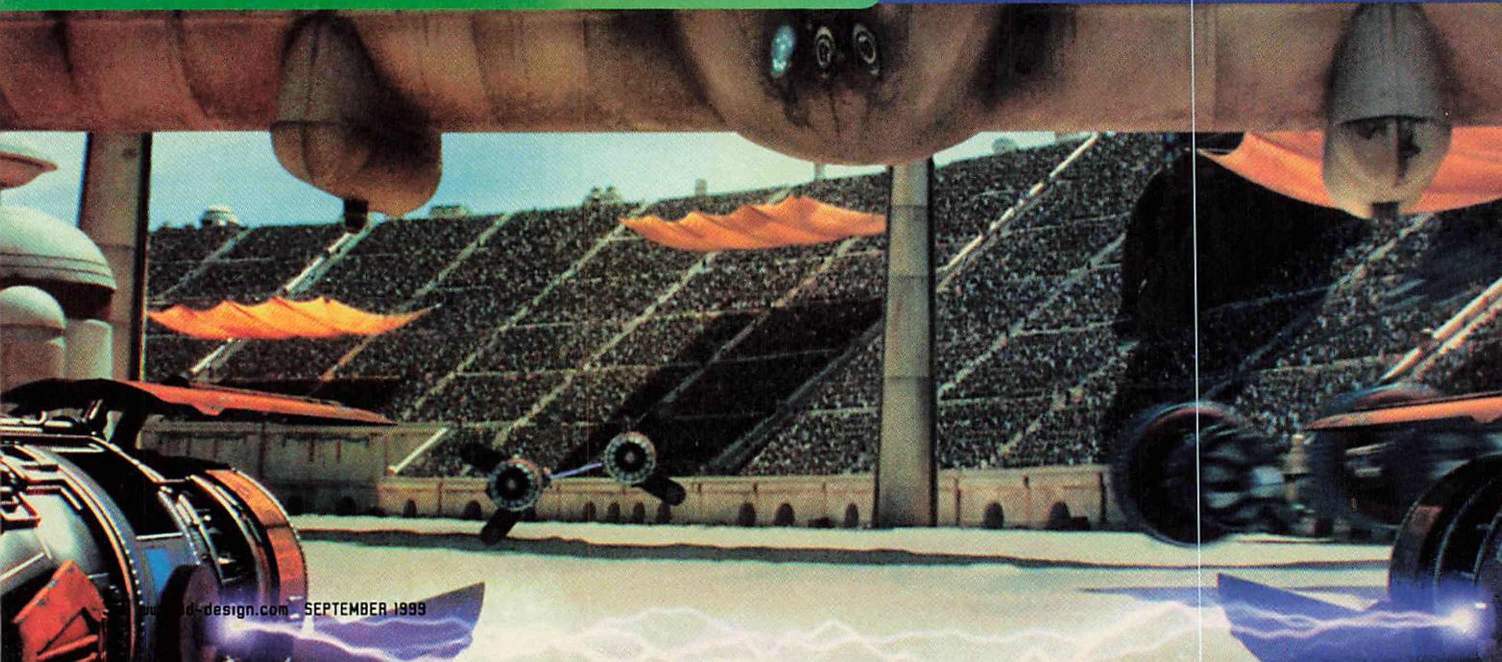
Mike Lynch, chief model maker at ILM, tests his concept for creating a stadium audience out of Q-Tips, using a blow dryer to generate motion.

Lynch's team populates stadium bleachers with Q-Tips of various colors to simulate a varied crowd.



Steve Gawley, Doug Chiang, John Knoll, and George Lucas (from left to right) gather around Lynch and his stadium of Q-Tips.

As the pod racers flew through the stadium, the Q-Tips swayed in the breeze.



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Rapid 3D #14

the case for practical effects over CG. "We built the entire stadium practically, and if you can get at least some of the crowd in there, you get interactive light, shadows, and so on." Even if the practical crowd becomes replaced by CG imagery later—which, in some shots, it was—the CG artists benefit from having a mock-up of the entire setting, shot in natural light, available for reference.

Lynch began with sketches created by design director Doug Chiang and architectural plans by architect Bill Beck. "The finished product looks very much like the original drawings," Lynch says. "We were well provided for in terms of information. A lot of times we don't get that much, but in this case, Doug Chiang really knew what he wanted."

Under the direction of model supervisor Steve Gawley, he built the 32 x 42-foot stadium model. Then he set out to fill the seats with hundreds of thousands of spectators.

First, Lynch cut head-and-shoulder silhouettes out of cardboard and attached them to cams, which he stacked to make rows. The cams allowed him to make the silhouettes undulate for a more realistic effect. It worked well, he found, in shots where the camera was low and looking up into the stadium. However, higher camera angles destroyed the effect, so he discarded this approach.

Instead, he decided to populate the seats with thousands upon thousands of Q-Tips—335,000 at final count, which he dipped into different colors of paint a fistful at a time. Stapling lengths of hardware cloth to the stadium, he dropped Q-Tips of various colors into the cloth mesh, which held up their heads while leaving their four-inch dowels hanging below. An electric fan positioned behind and below the bleachers made the dowels sway, giving the Q-Tip crowd a lifelike motion. "The dowels acted like pendulums," he says. "If you wanted to, you could make them do a wave."

Before launching into the project full-on, Lynch built and populated a small section of the stadium to see if this technique would be cost-effective. He installed roughly 1,500 cotton-headed spectators in a space roughly 1.5 feet square, which gave him a sense of how long it would take to fill the stadium. This section took nearly an hour and a half, including painting the heads.

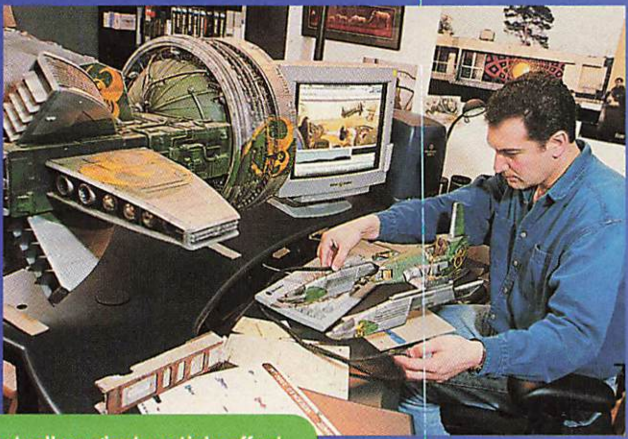
"Eventually, we built an entire stage for this shot outside," he explains, "with an airplane hangar on a track to cover it up at night. It was placed on a rotating base so we could position the set properly in natural sunlight."

Despite his ingenuity and hard work, Lynch was aware that his creation might be replaced by CG effects. "This was really just gravy," he says. "They could use as much of it as held up and fix whatever didn't work on camera. It was just something they didn't have to do."

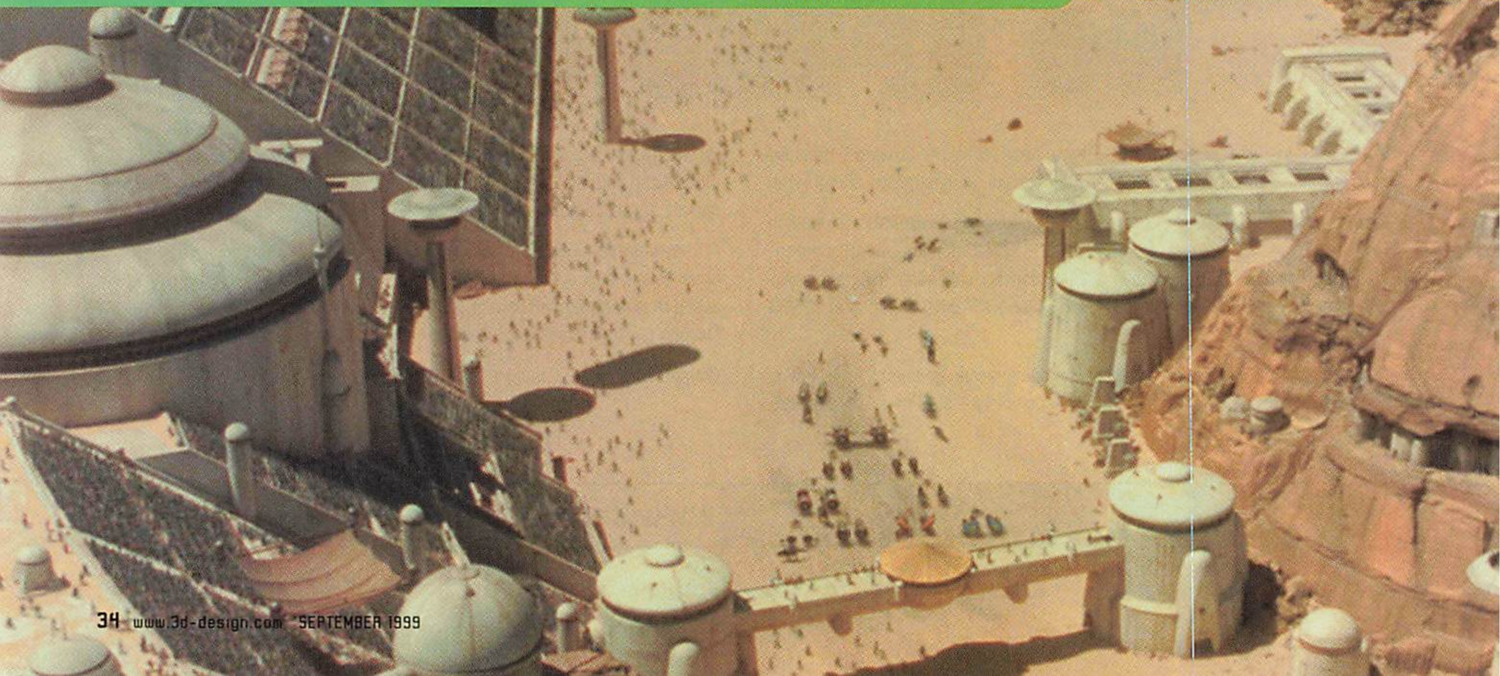
While Lynch was positioning Q-Tips, a film crew documenting the making of *The Phantom Menace* moved in for a close-up. He began to count, "Three hundred twenty thousand and two, three hundred twenty thousand and three…" Then he reached for a paintbrush with one tiny hair on it, and, heaving a deep sigh, he said, "Now it's time to paint the faces!"

Particle People Q-Tips may have worked in the bleachers, where audience members were seated and visible only from the neck up. Populating the stadium floor

CG supervisor Habib Zargarpour adapted a custom Maya plug-in designed for pod crashes to simulate the behavior of crowds.



These ain't no Q-Tips: the crowds of people on the stadium floor are actually a giant particle effect.

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Rapid 3D #15

and aisles with a milling crowd, on the other hand, required methods at the opposite end of the technology scale. In these shots, the team composited into the shots 3D imagery generated by a custom plug-in to Alias|Wavefront Maya and driven by MEL scripts. The plug-in made it possible to substitute geometry for particles, while the MEL scripts controlled their paths intelligently according to complex rules that mimicked the behavior of people in a crowd.

Initially, visual effects supervisor John Knoll enlisted Habib Zargarpour to help with the pod race—more precisely, the pod crashes. Knoll explained how he wanted the high-speed vehicles to crash, and Zargarpour created physically accurate rigid-body simulations.

Zargarpour had been visualizing instanced objects that appeared as tiny squares in Alias|Wavefront Dynamation or dots in Maya. Then Hiromi Ono of ILM's R&D department wrote a Maya plug-in that drew the objects themselves directly in the Maya GUI. This made it easy to add thousands of pieces of crash debris and preview their scale, rotation, and so forth, making the creative process far more interactive.

"One day I thought, 'Hey, wait a minute! We could stick people on these things,'" he recalls. "That thought segued perfectly into doing crowd simulations." Ono's plug-in was fast enough to render over 4,000 relatively small people in Maya's hardware rendering mode, including textures and shadows, making it possible to preview complex particle-based crowds in real time and even avoid exporting to Pixar Renderman for test rendering. Each crowd member was not quite an instance, but one of a selection of animated geometries. Moreover, their motions could be controlled by logic composed in a combination of Maya's dynamic expressions and custom code.

For his first simulations, Zargarpour used battle droid models, as they already had a library of mocap animation cycles. In one early test he showed me, several droids walk over hilly terrain. "If the hill's not too steep and the characters are walking fast enough, they can get over it," he points out, describing the logic that governs their behavior. "But if it's too steep, they'll go around it. You can imagine what it would take to animate this by hand."

Eventually, he replaced the droids with human models. Mocap cycles were attached

The people on the ground behind Watto are referenced geometry attached to particles and animated with Maya's particle system.

to the particle-based people, which were exported as prebaked Renderman .rib files. Renderman can combine .rib files under scripted control at render time. Using separate .rib files made it possible for Renderman to load character models only as needed, which saved time and processing resources and also simplified workflow should any changes need to be made later.

"Let's say you have an object, and you want to include 1,000 copies of it in a scene," Zargarpour explains. "One option is to instance the object, but that requires a lot of rendering overhead. Another option is to encode it into a single .rib file. Renderman can merge chunks of data from various .rib files into the main .rib, and you can set it up so it loads the object only when it comes into view. The person that made that workable was Christophe Hery," CG sequence supervisor for the ground battle between the battle droids and the Gungans, in which the immense number of characters made rendering a special challenge.

The aliens in the sequence were keyframed by hand, match-moved, and composited later. To add the final degree of realism, live-action footage was composited in, seamlessly mingling real and CG characters. Sometimes Zargarpour himself had difficulty differentiating human actors from their digital equivalents. "We made takes in which the CG people would flicker," he says, "so we could tell what was real and what wasn't."

It took some experimentation to finalize the logic behind the crowd intelligence. In one test, as the crowd meandered toward the stadium doors, characters bumped into walls repeatedly before finding the entrance. "That was when we didn't have much intelligence built in," Zargarpour says. "They try

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Rapid 3D #16

Stampeding creatures are animation cycles following a 3D spline path.

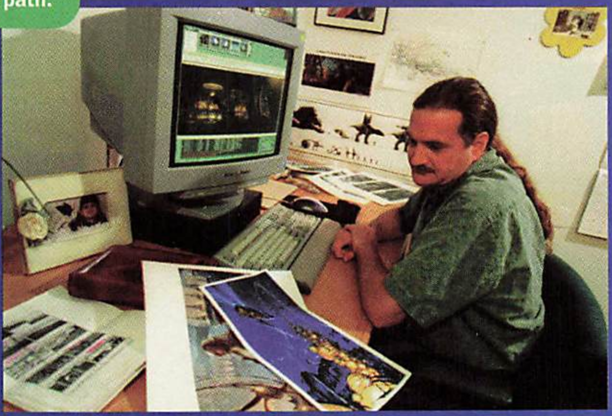
one side, then the other side, and finally they make it in. Of course once they make it in, they die, because we don't need them anymore," he concludes cheerfully.

Little by little, Zargarpour gave crowd members the intelligence to find their way through the stadium doors, through corridors, along railings, and the like. To make them even more lifelike, he added behaviors that enable them to make friends. When two characters come into close proximity with one another, they can become companions and walk in tandem. As they approach other characters, they can leave their original partners and join new ones. This lent the crowd's motion complexity while avoiding the impression of randomness.

One of Zargarpour's most ingenious techniques involves "carrots and skunks." A carrot is a null object that tends to attract individual audience members. A skunk tends to repel them. This made it possible to control the crowd's overall motion without determining it absolutely.

How does Zargarpour approach the task of programming rule-driven automated animation? "I imagine what the rules are," he replies simply. "Whether walking can go to running, or dying, or whatever. Then I ask, what conditions cause a transition to happen? Then you start getting into the trench of actually doing it, and that's where you're going to hit stumbling blocks. The computer is only able to do what you tell it to, nothing more."

Having overseen large-creature sequences as a technical director for *Jurassic Park*, CG supervisor Tom Hutchinson choreographed the forest stampede.



Cloned Creatures Compared to the artificially intelligent digital humans in the stadium, the creatures that inhabit the swamps of Naboo are brain-dead. When Federation ships land on Naboo, sending ground troops and battle droids barreling through the forest, a stampede ensues in which all manner of alien beasts run along fixed paths, every frame of which was analyzed and tweaked.

The heaviest shot in the sequence includes roughly 35 creatures—an assortment of peko pekos, pikobis, motts, ikopis, nunas, and fulumpasets, all of which were derived from a wire model of a dog in the ILM database. "They're not in the hundreds like in other sequences," remarks CG supervisor Tom Hutchinson, "but it was pretty significant."

Hutchinson's background prepared him well for animating large photorealistic creatures. His accomplishments at ILM include work on *Jumanji* as well as the sequences in *Jurassic Park* in which two raptors tear through the kitchen and the T. Rex chases the lawyer to the bathroom. For the stampede sequence, his team included five animators and six technical directors (TDs). "It fluctuated a lot, though, because at the same time we were working on the underwater chase sequence," he says. "We pulled TDs back and forth, and our R&D people were working on the ground battle sequence at the same time."

Using a proprietary application called Choreography, Hutchinson and his team attached animation cycles to the models and set them running along spline-based paths. "We could get lots of creatures going and manipulate their paths without worrying about the geometry at the same time," Hutchinson says. "The schedule on this was a fraction of the time we had on *Jumanji*." Whereas Maya was used extensively in other crowd animation shots, Choreography and Softimage|3D were used to visualize the stampede.

Choreography is fairly intuitive, Hutchinson explains. "You load up the 3D environments, basically the match moves from a Softimage file, then lay out a 3D spline path where you want the characters to move. Then you assign animation cycles to each of the various paths. From that point on, you can load snippets of animations or cut them out in a very interactive way."

The majority of the animation time was spent making the basic animation cycles as

realistic as possible. These cycles were copied among animals of the same type and then enhanced with head turns, jumps, moving around obstacles, and so on. The animators worked together, with some of the team focused on blocking out the animation and others whose job was to tweak secondary motions and other seemingly minor yet critical details.

Since the cycles were freely duplicated, it was necessary to vary them to keep the crowd from looking mechanical. "That was ongoing, and we really had to discover what worked, depending on the shot," Hutchinson recalls. "Once we got one cycle of animation, between 60 and 120 frames, [visual effects supervisor Dennis] Muren would say, 'OK, let's pick a couple of others, and we'd vary them to make a library of three or four cycles for each character. Let's give this guy a limp or whatever.'"

The skeletal setups posed their own challenges, especially that of the lumbering fulumpasets. "They've got no real mass over their hips," Hutchinson observes. "They're designed for looks rather than for proper locomotion. They really work best coming head-on."

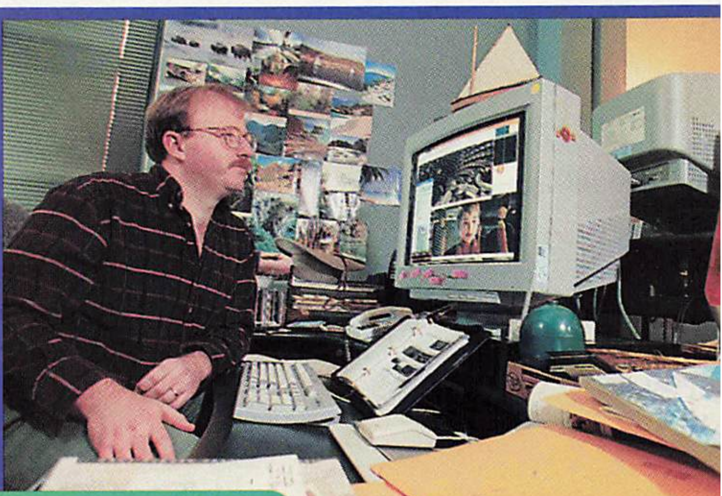
Much of the technology involved in making these animals move realistically evolved from research and development done for *Jurassic Park*. "The software has been progressing at a pretty quick clip," Hutchinson says, "so more of the power comes for free, depending on how the bone structure is animated and enveloped."

Apart from the animation, creating the environment itself was a major effort—everything in the sequence was 2D except the animals. "There's a whole background plate that was synthesized mostly from still photography that we cut and pasted together," Hutchinson says, "along with a lot of work from the matte and art departments." To make trees fall and break apart as the animals ran by, he sought out tree-cutting crews and filmed them at work. "We had a few windy storms in the area," he recalls. "We got in touch with power company ground crews and shot them cutting the trees down. Then we comped them into the sequence."

More surprising still, the space ships were practical models. This posed a problem as the work progressed and it became clear that the scale in which they were filmed wasn't appropriate. "The scale depends on the camera's lens and angle, as well as how distant it is from the object," Hutchinson explains. "If you're assuming a ship is going to be a certain distance away, it may be moving too fast for the scale it was shot in. As we developed the sense of scale and progression, we had to go back and reshoot them."

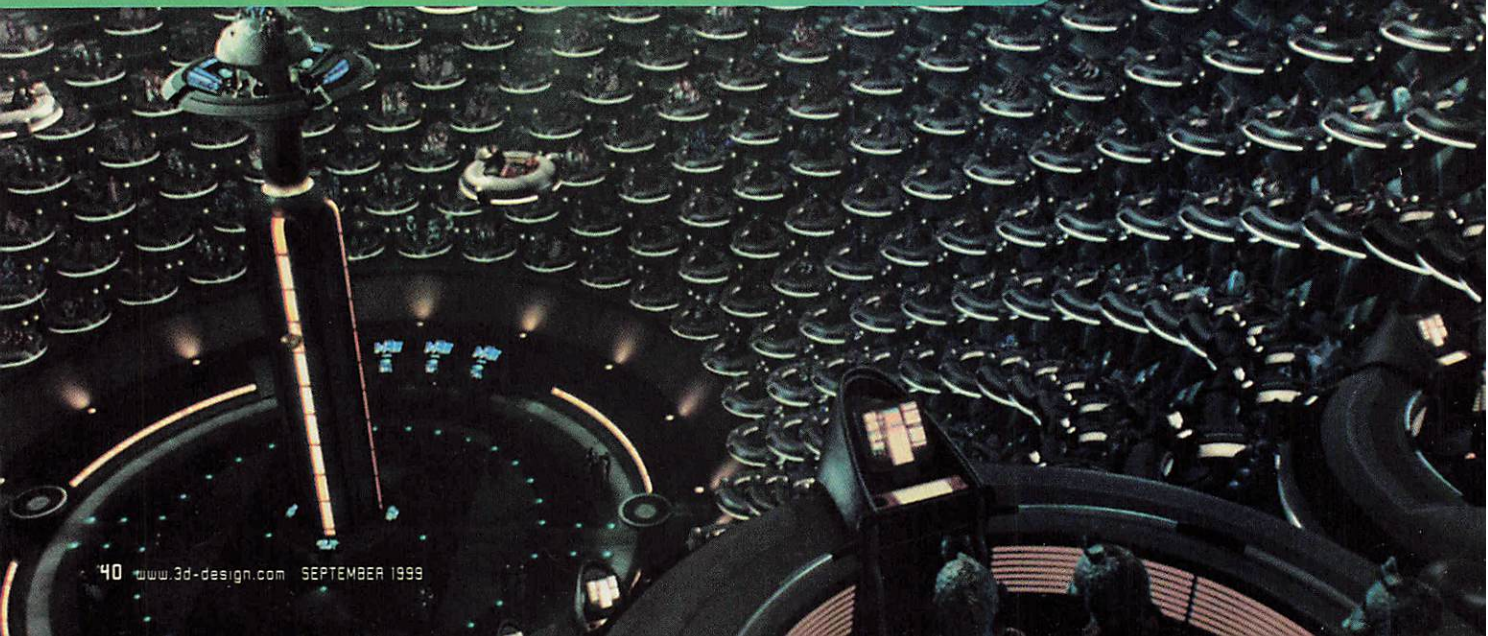
Committee of Cards If the way in which Naboo's 3D swamp creatures were composited against 2D background elements has become conventional in cinematic effects, the melding of 3D and 2D in the Senate chamber turns convention inside out. The chamber, its cavernous interior lined with innumerable pods that hold delegations from across the galaxy, is literally a house of cards. Each pod holds cards onto which the ILM team projected precomposited imagery.

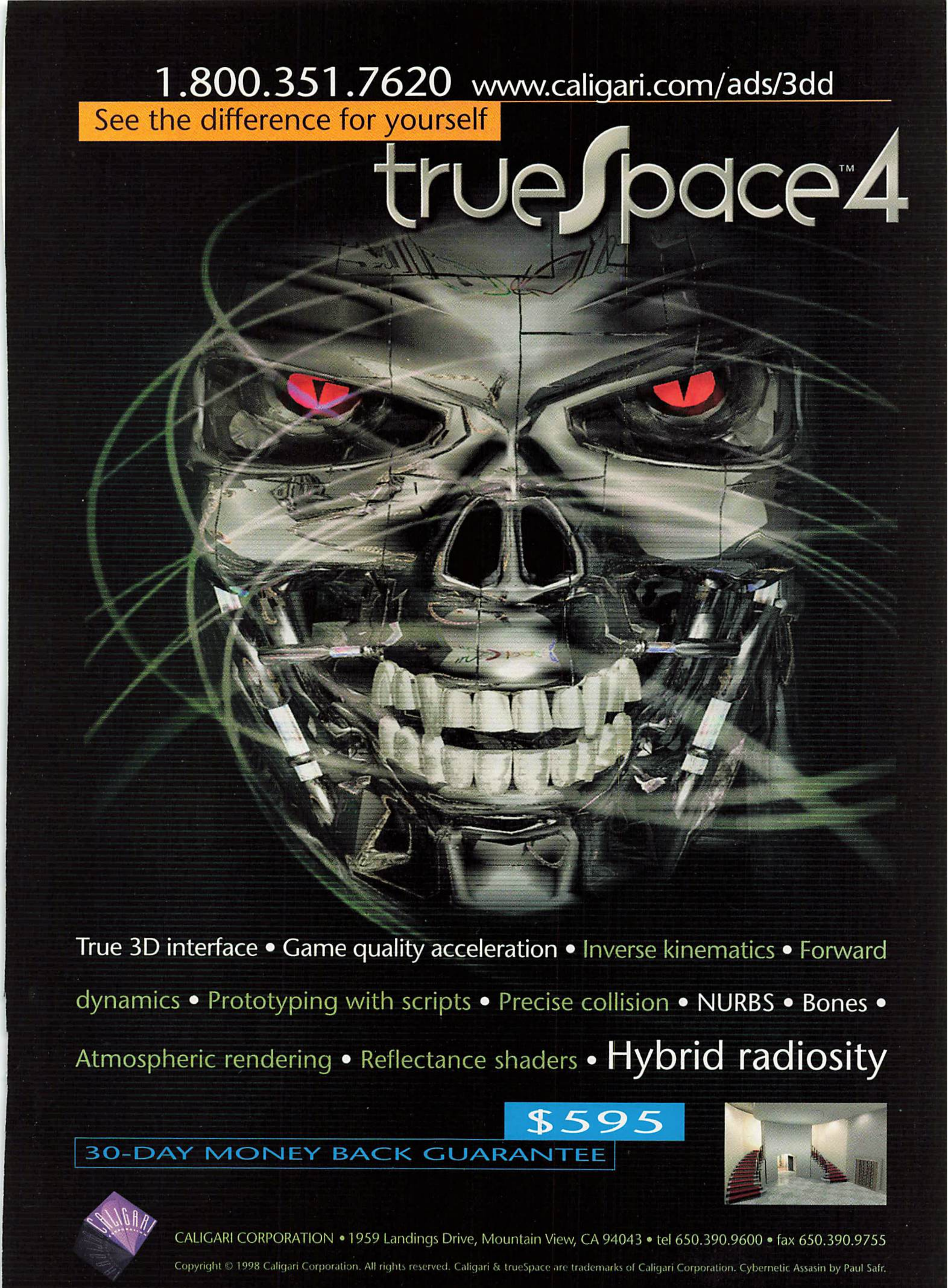
As the sequence progresses, it becomes evident that the pods can detach from the wall and fly into the center of the room, where the representatives they carry can address the Chancellor or others face to face. The flying pods were made up of a



CG sequence supervisor Steve Molin projected precomposited footage onto a spherical array of 3D cards to create and populate the cavernous Senate chamber.

The 1,024 pods in the Senate each contained 3 to 5 characters, which were projected onto 3D cards.

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combination of 3D models and practical models.

Development of the chamber began late in production, in November 1998, when CG sequence supervisor Steve Molin started making previsualizations based on Doug Chiang's sketches. Molin moved to ILM eight years ago from a defense contracting company, where he got his first taste of 3D on Silicon Graphics Irix boxes. Previsualization was critical to the scene—indeed, to the entire film—because the animatics provided a basis for the 3D work.

"Based on the animatics," Molin explains, "we did camera match moves for the whole sequence, so we could get a handle on which camera angles we were going to need. Before we started, we had a pretty good idea what needed to happen."

What needed to happen was not simple: First, the team had to rustle up enough characters to fill 1,024 pods, each containing between one and five humans and/or creatures. Then the delegation occupying each pod needed to be shot or rendered from a "comprehensive" variety of camera angles, sufficient to cover all of the camera motion planned for the sequence. The footage was composited onto cards, and finally the cards were switched from footage shot at one angle to footage shot from another to match the camera moves.

"We didn't have that many unique creature elements," Molin recalls, "so we had to do some repetition to fill the whole scene. Many of the creatures from the film were reused to populate the Senate chamber, such as the creatures in the pod race.

"If you look at our database of image elements," he continues, "we have the creatures shot from different elevations and azimuths, and then we distributed them based on the camera angles using a MEL script in Maya. The images that corresponded to the camera angles were mapped to flat planes and composited into the scene using alpha channels."

The camera angles used in the footage didn't always align with the match moves exactly, and subtleties such as shadows and lighting weren't precise either. But Molin didn't consider this a problem. "This stuff was far enough away from camera that we didn't really worry," he admits.

"When we were starting work on the sequence, we looked at the plates they had shot for us, mostly for the hero characters"—that is, those who are relatively close in frame—"and tried to select a generic lighting environment for them. That way, as we changed the angle of the people to match the camera motion, they had a repetitive lighting model. As we got into the closer stuff, we stayed with the lighting arrangement that matched the lighting of the main characters."

Ultimately, careful planning was the factor that enabled the team to complete such a complex task in a very short time – but it didn't hurt that the setup was the part Molin found most rewarding. "I got a kick out of being able to set it up so that when the TDs started running shots, it was easy for them to generate imagery in a fairly short time span. For some of the easier shots, we had a three- or four-day turnaround, which is just amazing from my point of view. Anticipating problems and helping people solve them was probably my favorite thing."

motion-capture

Motion capture is a volatile subject among 3D artists. Many see it as a poor substitute for keyframing at best. Others envision a dark future in which mocap will have replaced their artistry altogether. While mocap can be a panacea in some cases, it's a nightmare in others.

Nobody understands this better than technical animation and droid supervisor James Tooley, who oversaw the capture and application of motion files for the droid army in the ground battle between the droids and the Gungan cavalry.

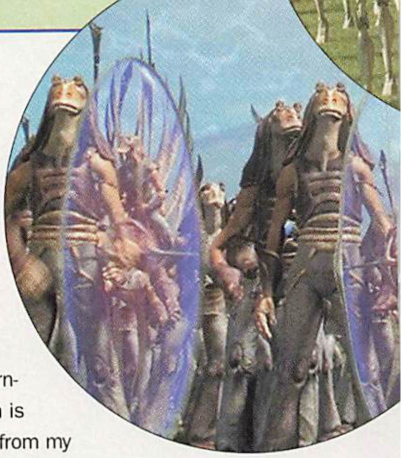
"The droids used a lot of motion capture, and they also had to be sliced and diced by lasers, so I dealt with the dynamic simulations for that too," Tooley explains. "We wanted to be able to produce as much motion as we could. Once you have control over the technical aspects of getting the motion files onto the models, the rest is just a matter of how fast can you capture motions, clean them up, and get them into the animation."

Mocap, which is designed to capture the subtlety of actual muscular motion, isn't the most obvious choice for animating mechanical robots. However, Tooley found that it worked beautifully. "The droids only have two bones in their spines," he observes. "If you apply a curvy motion from a human onto that, you lose resolution in the spine, so it ends up looking mechanical, which is fine for the droids."

The optical mocap process they used translated the positional data generated by optical sensors attached to the mocap performer's joints and triangulated their positions in 3D space using specialized cameras. "We chose optical over magnetic because there's no umbilical cord and no backpack involved," Tooley explains. In addition, he points out, optical is more precise and less prone to magnetic distortions.

Tooley and his crew had to plan their work carefully to capture the motions they needed. In the one sequence in the ground battle, the droids push through the Gungan energy shields, straining on one side, then nearly falling through to the other. Mocap supervisor Jeff Light came up with a clever approach to creating the right kind of motion. "We had a rope harness on the performer, and as he moved forward, somebody held the rope, which gave a leaning-over-forward look. Then they just let go of the rope, and the actor had to take a couple of steps to regain his balance. Of course, because it's mocap, you don't see the rope or the person holding it."

For motions that were intended to be applied to Gungans, a special technique was used to deal with the difference between human and Gungan anatomy. "The Gungans had really tall necks," he points out. "To extrapolate from the human head to the Gungan head, we had a specialized rig that would offset the motion and expand the rotations, or otherwise amplify the motion, to make the head work correctly."



techniques for a disposable army

After the data was captured, it was fed through a proprietary conversion program called MC2ANIM. The software automatically scales the data to an IK-constrained character model and applies it in a way that, according to Tooley, makes it look less mechanized and simplifies tweaking the data. "A lot of the battle droids and Gungan warriors had such good conversions, that they were almost plug-and-play," he relates. "The resulting animations didn't have any noise problems or glitches."

"For the hand to hand combat," Tooley continues, "they were keyframing a lot of complex motion. Although we did use some of the keyframed data, we went back to the stage and reshot two people actually struggling hand-to-hand. Then the animators came in and helped clean it up. Maybe a hand wasn't completely connected to an arm because of differences in the physiology of the mocap actor and the model, so we had to do minor reconstraining to replot the droid's hand back to gripping the Gungan's arm, for example."

An extensive array of proprietary tools made the mocap process more efficient by giving Tooley and his team a great deal of flexibility in how they applied captured motions. "Using a proprietary tool we call MoJo," he reveals, "we could take multiple pieces of mocap, align or offset them in time, and blend from one to another. For more complicated blends, we used another in-house tool to change the path of the motions. That is, the actor may have been mocapped straight down a path, but we may apply the motion to another path. MoJo helped us take care of the leg placement and so on."

Yet another in-house tool helped blend the start and end of the mocap cycles. "A person who does a walk cycle won't have the start and end motions exactly the same," he explains, "so we used a shearing tool that compared the beginning and end frames and automatically blended between them to create a seamless loop."

In other sequences, re-using motion threatened to impart a uniformity that worked against the impression of a believable crowd, but the droids turned it into a virtue. "They were what George called a disposable army," Tooley says. "They had to look like they came from the same mold and had the same programming. I decided that if we were going to use mocap, we had to use one person to do all of it. If you get somebody who's really good, you can do a piece of motion and then have them do it again ten days later, and it will be almost dead on.

"It's not as easy as it looks," he continues. "It's like acting in a way; you have to hit certain beats at certain times. But it's also making your body move just right, like pantomime. I regard it as an extension of traditional animation, but instead of using a mouse to get my input, I can use my whole body."

It's surprising to find a technician with such a fine appreciation of performance, but Tooley knows what he's talking about. Asked who performed the droid motions, he replies, "You're looking at him."

Duplicate Droids

By far the most complex sequence in *The Phantom Menace* is the final ground battle between the Gungans and the battle droids. As the Federation prepares to wipe out the brave but seriously outgunned Gungans, 7,000 characters pour across the screen in a single shot. The fact that they were all derived from only one battle droid and one Gungan didn't make matters any simpler: the combined weight of all the models, motions, and elements amounted to a staggering 70 gigabytes.

With thousands of characters driven by hundreds of animation cycles and distributed

ground battle sequence stats

A few statistics from the production of the ground battle between the Gungun army and the Federation's battle droids:

Number of cycles:

- Gungan cavalry/kaadus 27
- Gungan infantry 55
- Bdroids 48
- Ddroid, faamba, fulump, catapult, aat 13

Total number of cycles/animations checked-in and baked: 143

Total number of frames for all cycles: 27,534

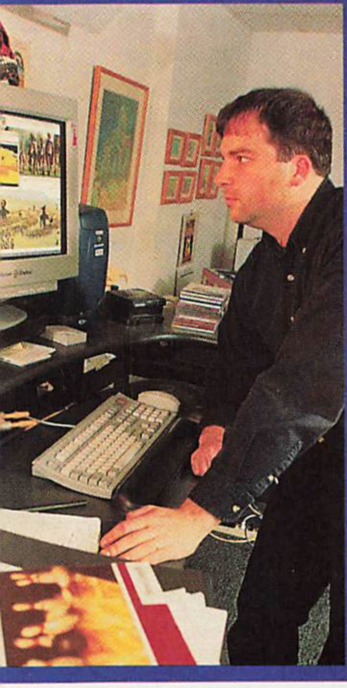
Average number of frames per cycle: 192.5

Total number of .rib files baked (includes multiple resolutions and cycles with multiple creatures): 87,490

A typical shot (code name ggbb038):

Amount	Description	Number of cycles used
3	Faamba	2
248	Infantry throwing balls	1 (almost hidden)
114	Infantry with shield in front	3
2,048	Walking and dying droids	13
2	Balls thrown from catapult	1
395	Balls thrown by infantry	1

The ground battle sequence was laid out in Maya and driven by MEL scripts.



By optimizing the rendering pipeline, CG sequence supervisor Christophe Hery got as many as 7,000 artificial characters per shot into the ground battle scene.

at varying distances from the camera, previsualization—in stark contrast with the Senate chamber sequence—was no help at all. "We started with an animatic," explains CG sequence supervisor Christophe Hery, "but that's better for hero shots than it is for large crowd scenes. A lot of research was necessary for each shot, and at the same time we were doing the research and design for the tools we were building. It was kind of scary to see everything, not knowing how it would come together."

Hery is a Renderman master, and Dennis Muren approached him in June 1998 to develop strategies for rendering the battle sequence's vast amount of data. From there, he went to work increasing the efficiency of the crowd animations. It's not exaggeration to say that many of these shots would not have been possible without his optimizations.

The battle was laid out in Maya and driven by MEL scripts that allocated animation cycles to groups of characters while conforming their animations to the terrain and avoiding collisions. The basic animation library was imported from Softimage|3D with details such as flapping Gungan ears and cloth simulations added in Maya. All the Gungan warriors were derived from one model and likewise for the battle droids, with seven variations of coloring and texture and variations in scaling and proportion added randomly via MEL scripts.

The Gungan warriors' animation cycles were mostly keyframed. The battle droids, on the other hand, were motion-captured by technical animation supervisor James Tooley. "I deal with animating things that tend to be mathematically or technically difficult," he says. Tooley, who came to ILM five years ago by way of Disney, also served as droid supervisor at large.

As in the shots of the stadium floor and aisles, plug-ins incorporating technology developed by Habib Zargarpour provided very fast animation previews. However, unlike the characters on the stadium floor, an enormous number of characters in the battle sequence needed to be seen relatively close in frame, so optimizing rendering time was critical. "We could see a hardware render of the crowd in Maya almost in real time," Hery reports, "so we were able to refine it as much as possible before we hit the render button."

One such refinement involved distributing droid animation cycles judiciously, so the smallest amount of data could generate the greatest range of motion at render time. Many droids shared exactly the same motion file, which was appropriate for a phalanx of mass-produced fighting machines designed to serve as a disposable army. However, Tooley made sure to introduce variations. He set up various prebaked .rib files, each containing the same motion file augmented by a head turn to the right to survey the landscape, a head turn to the left, or another subtle difference.

Having optimized the crowd animations, Hery took a careful look at the lighting setups. "We came up with a compromise that would give it a good daytime look," he says, without unduly contributing to the time required to render. "We used between five and eight lights, depending on the shot, not all the lights cast shadows."

To create interactions between the characters and the grassy field in which the battle takes place, the team began with photographs of matte paintings depicting the field. "All we had to do was make it look like the foot was inside the grass," Hery explains. "It was just a simple shader with some noise to break up the edge of the bottom of the feet." No collision detection was involved—merely a visual trick, and a cheap one at that, at least in terms of render time.

Rendering took place in three passes: a beauty pass, a cast-shadow (or depth) pass, and a foot-in-the-grass pass. For the beauty pass, Hery set up Renderman to load geometry on an as-needed basis. "We baked the .rib files with animation and motion blur," he explains, "but instead of baking in the geom-

© Copyright Fox Sports. Image courtesy of Digital Dimension.

"We needed to find a way of dealing with the huge computing loads that serious ray tracing presents..."

The Super Bowl is the single biggest event in broadcast television, with up to 800 million viewers worldwide. This year, Fox Sports was looking for someone to produce a visually stunning animated opening sequence for "*Super Bowl XXXIII on Fox*". They turned once again to Emmy award-winning Digital Dimension, a North Hollywood-based studio specializing in 3D animations, motion graphics, and visual fx.

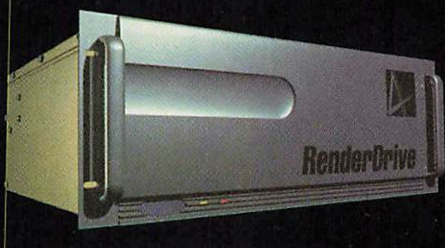
Digital Dimension faced a number of challenges. First of all, the project needed to be completed rapidly. With a short time to complete the job, and lots of creative interaction with Fox expected, speed was of the essence. Secondly, while much of the sequence could be done using conventional tools and methods, the inclusion of large stretches of water and a gigantic replica of the Vince Lombardi Trophy meant that they would have to be ray traced in order to achieve the level of photorealism required.

Normally, installing the rendering resources on the scale required by a project of this complexity would have been a difficult, expensive, and time consuming process. But thanks to RenderDrive's revolutionary rendering technology, it proved quick and trouble free.

Fox Sports loved the finished results, and Digital Dimension's animators loved the quality and power of the RenderDrive. In fact, they may need to break out their dress shoes again for this year's Emmy awards ceremony.

"We could not have done this project in the time allotted and to the quality standard that Fox requires without the power, speed and increased interactivity that RenderDrive gave us."

Ben Girard
General Manager, Digital Dimension



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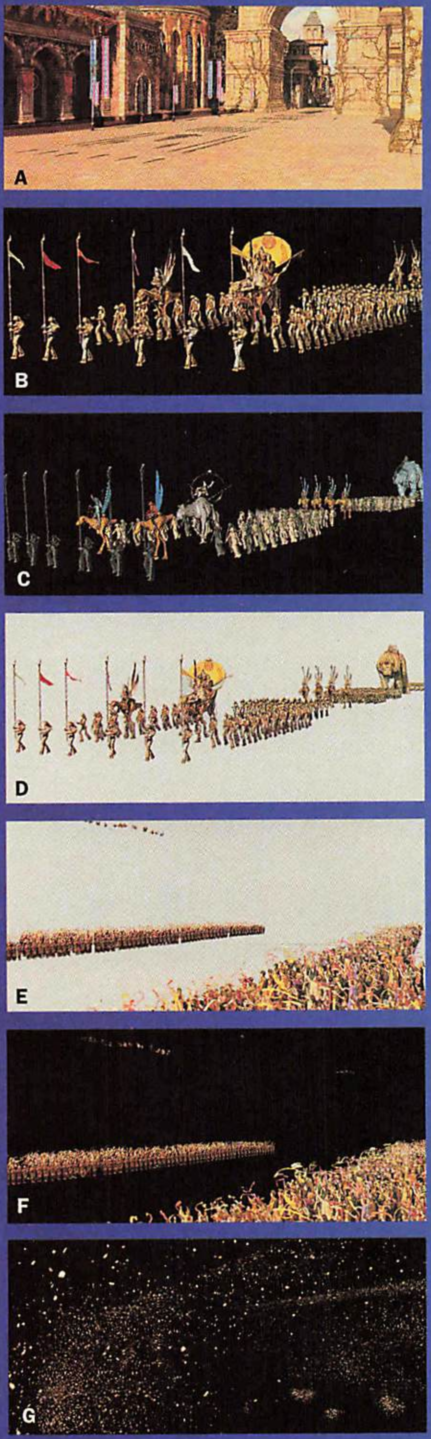
etry, we used a feature called delayed read archive, which is also known as procedural primitive. When you start the .rib, there's no geometry in it. Renderman checks for bounding boxes that we provide, and if a bounding box intersects the pixels currently being rendered, it loads the geometry."

To further conserve rendering resources, Hery took advantage of Renderman's Level Of Detail (LOD) capability, which automatically selects among low-, medium-, and high-resolution versions of a model depending on the amount of screen space it occupies in a given frame. "The idea is that the low-res version will appear when the model is far away, while the high-res version will appear when it's close in frame," Hery explains. "In some cases, we pushed the medium-res version as close [in frame] as we could to conserve memory." It was necessary to make sure various LOD versions of a character had the same skeletal setup so the animations would transition properly from one to the next.

Not all the battle's close-in-frame characters were rendered in this manner. Some were treated as hero characters: keyframed in Softimage|3D and Cary (ILM's proprietary facial animation tool), rendered separately, and composited in post. However, many of the characters that appear close in frame actually were treated just like characters with less prominence. This made Hery's job much simpler—otherwise, there would have been too many hero shots to manage.

Composite Crowds Every crowd-scene technique we've examined so far required that the synthetic extras be three-dimensional. For the crowd that lines the street during Gungan victory parade that closes the film, the ILM team decided to use 2D extras. Shooting several small groups of people against a bluescreen (for film) or greenscreen (for digital video), the shots were composited to create two dense rows of adoring onlookers. The tricky part, though, was to position these shots coherently into the 3D scene—a task that fell to CG sequence supervisor David Meny and compositing supervisor Greg Malony.

"The crowd extras were shot in blocks of six by four or six, so we had more than 100 squares of 30 people in different variations," explains Meny, who began his career at ILM four years ago after graduating from California Polytechnic University with a summer intership and parlayed that into a job as ani-



The parade sequence, in which the Gungan army parades to Queen Amidala's palace to celebrate their victory over the Trade Federation's battle droids, was assembled from a variety of practical, video, and CG elements. The buildings on the live-action set were no more than eight feet tall; they were augmented by CG buildings in the background plate (A) with a cast shadow pass on the ground. A test using low-res meshes of the Gungan army was rendered (B) followed by a test using hi-res models (C-D). A crowd of spectators (E-F) was shot in small groups of roughly 30 people and composited into the scene using Softimage|3D to position of the groups. No parade would be complete without confetti (G), most of which was created in 3D and comped in later.

The final parade scene combines live-action, 2D, and 3D elements to create a spectacle.

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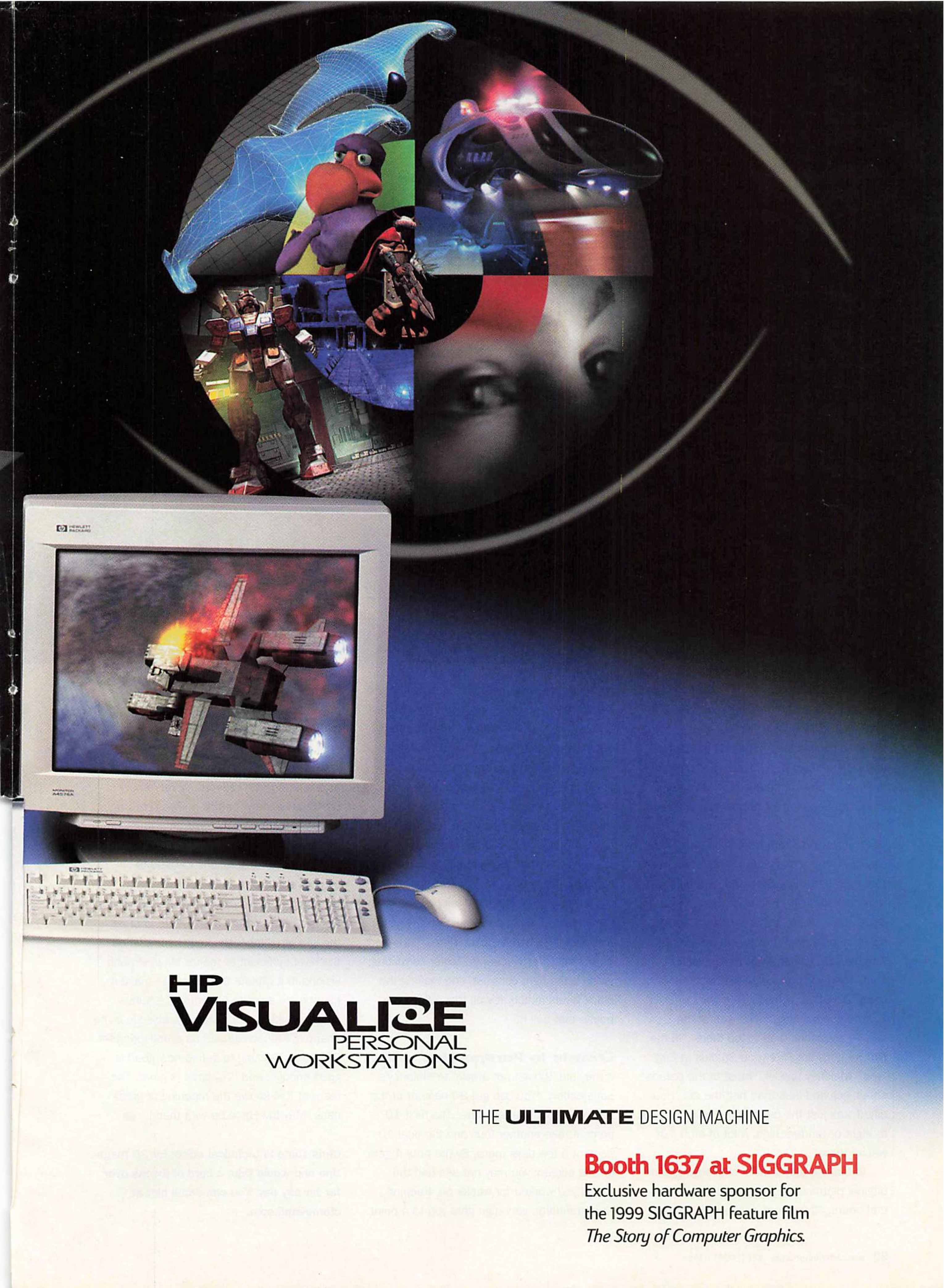
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mator. After working on the ground battle sequence, he was charged with helping to animate the parading Gungans as well as the CG confetti.

"We could have eyeballed them together," he continues, "but that would be painstaking with more than 100 elements just for one shot on the street. Then I got the idea: We had the CG set in Softimage|3D to animate the Gungans parading down the center of the street, so why don't we just lay a grid on the plaza floor to determine where the 2D crowds should go? As long as the grid had enough resolution, we could figure out where each crowd element should be positioned. That made it easier for the compositors, since they could tweak two numbers instead of having to deal with exact pixel locations. The grid also helped them adjust the scale of the crowd elements toward the horizon. It made things much more manageable."

Maloney, who worked as a photographer before joining ILM's optical department in 1989, agrees. "By tracking it this way," he says, "we were able to take a radical match-move with a moving camera and lock the greenscreen elements to those 3D points in space. A lot of stuff we did depended on having a really high quality match move." The artists brought the plates into Softimage|3D. Then they got the floor-plane coordinates to overlay the images on the plates and locked down the 2D elements. "After we got our first row of people on," Maloney says, "it became a lot of noodling and hand work."

"For the big shots where you see all the way down the street," Meny adds, "we were fortunate that most of the camera angles were lockoffs. Only one shot was a pretty crazy move, where it started high, tilted down, and followed the parade to the right. It makes life easier if you have a lockoff shot. Then you can weigh the benefits of using 2D, 3D, or a mixture."

The compositing challenges of the parade sequence didn't stop there. "In the film we got from Pinewood Studios in England," Maloney recalls, "most of the parade shots included less than half the set. Usually, it was just the base of the buildings, up to eight or ten feet high. A lot of stuff just wasn't there."

To make matters more challenging, the original plates were shot outdoors over several hours. "If you look at the end parade with a critical eye," he points out, "you'll see the shadows going all kinds of ways. Some shots were shot on overcast days, some on sunny days, and so on. We had to bring all those plates into into some kind of visually congruent space." Maloney got the matte paintings, the model shots and the CG to match as closely as possible, working with color, matting, and isolating different areas to correct for the inconsistencies in the lighting.

To correct the lighting, Maloney sat down with visual effects supervisor Scott Squires and decided when it looked right. "It's a sort of a cheat," he comments, "color correcting, giving it the right contrast, and making the black levels match. It's all those fine little points that sell it."

Crowds In Perspective And sell it they did, though not always to Maloney's satisfaction. "You can get 80 percent of the way on a shot in a few days. The next 10 percent take another four, and the final 10 percent a few days more. By the time it gets on the screen, you may not see half the things you worked for weeks on. Keeping your standards very high gets you to a point you can be happy with. We feel like we've pushed it as far as we need to. But it's my job to push and push and push until the supervisor tells me to stop."

He pauses for a moment. "It really is an evolution," he reflects. "Every show builds on a show before it. Two years ago I don't think we could have done this movie."

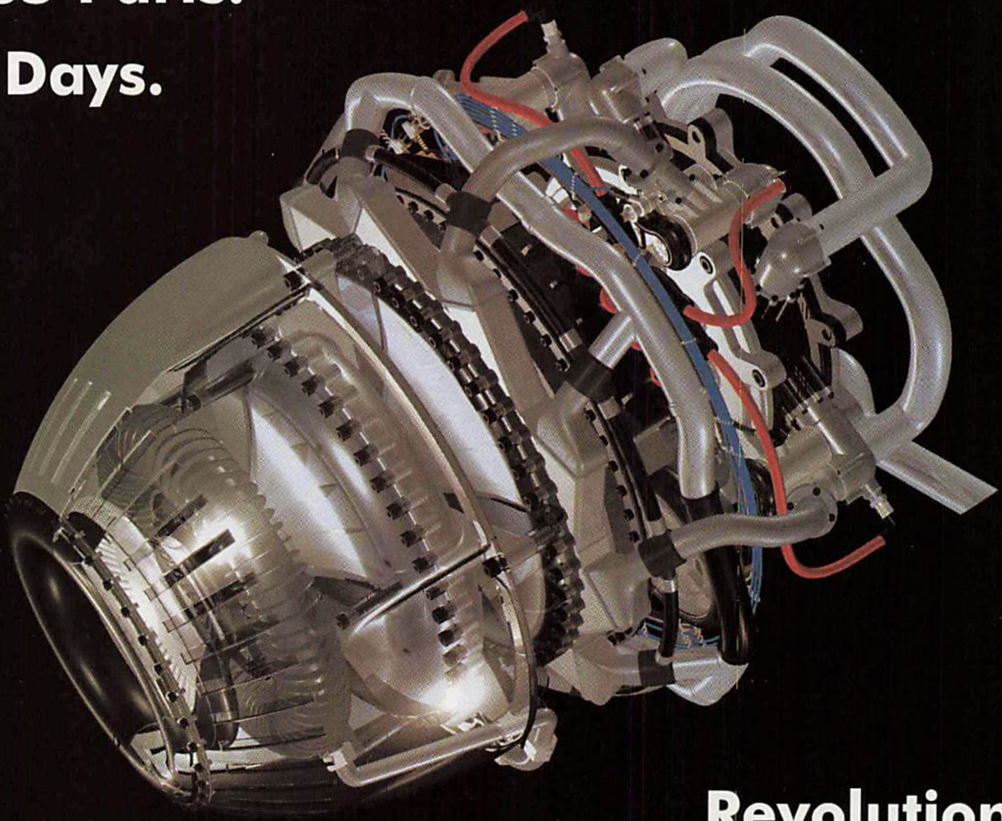
The range of solutions devised to achieve these awesome scenes was as diverse as the people who thought them up. George Lucas waited many years until he thought graphics technology had reached the level sufficient to realize his cinematic visions, but without the people to make it happen, no amount of computing horsepower would matter. *Star Wars Episode I: The Phantom Menace* serves as a wellspring for CG artists seeking to define how good is good enough, and how good is great. The team at ILM knows the meaning of greatness. May the Force be with them!

Chris Tome is technical editor for *3D* magazine and would take a herd of Ewoks over Jar Jar any day. You can email him at ctome@mfi.com.

Using Softimage|3D, David Meny, CG sequence supervisor for the Gungan victory parade, calculated the screen positions into which to composite the numerous small-group shots that made up the crowd.

Compositing supervisor Greg Maloney, seated at his workstation, discusses the requirements of a shot with Barry Armour, computer graphics supervisor.

1 Engineer. 1 Idea.
1165 Parts.
20 Days.



Revolutionary.

For a long time industrial designer Simon Floyd had an idea for a new type of engine. He also had at his fingertips one of the leading "high end" CAD systems, but the one thing he didn't have was spare time. "This is a complex assembly and the task of designing it in any conventional CAD system was just too daunting. However, once I got my hands on IronCAD, I finally had the power to realize my vision," says Mr. Floyd. IronCAD's unique Drag & Drop Solid Modeling and Design Flow™ Architecture gave him the power to not only work fast, but to innovate while he designed. He's become so enthusiastic about IronCAD, he now offers it to his clients. To see a case study of Simon Floyd's awesome engine design and to learn more about how IronCAD is powering the next industrial revolution, log on.

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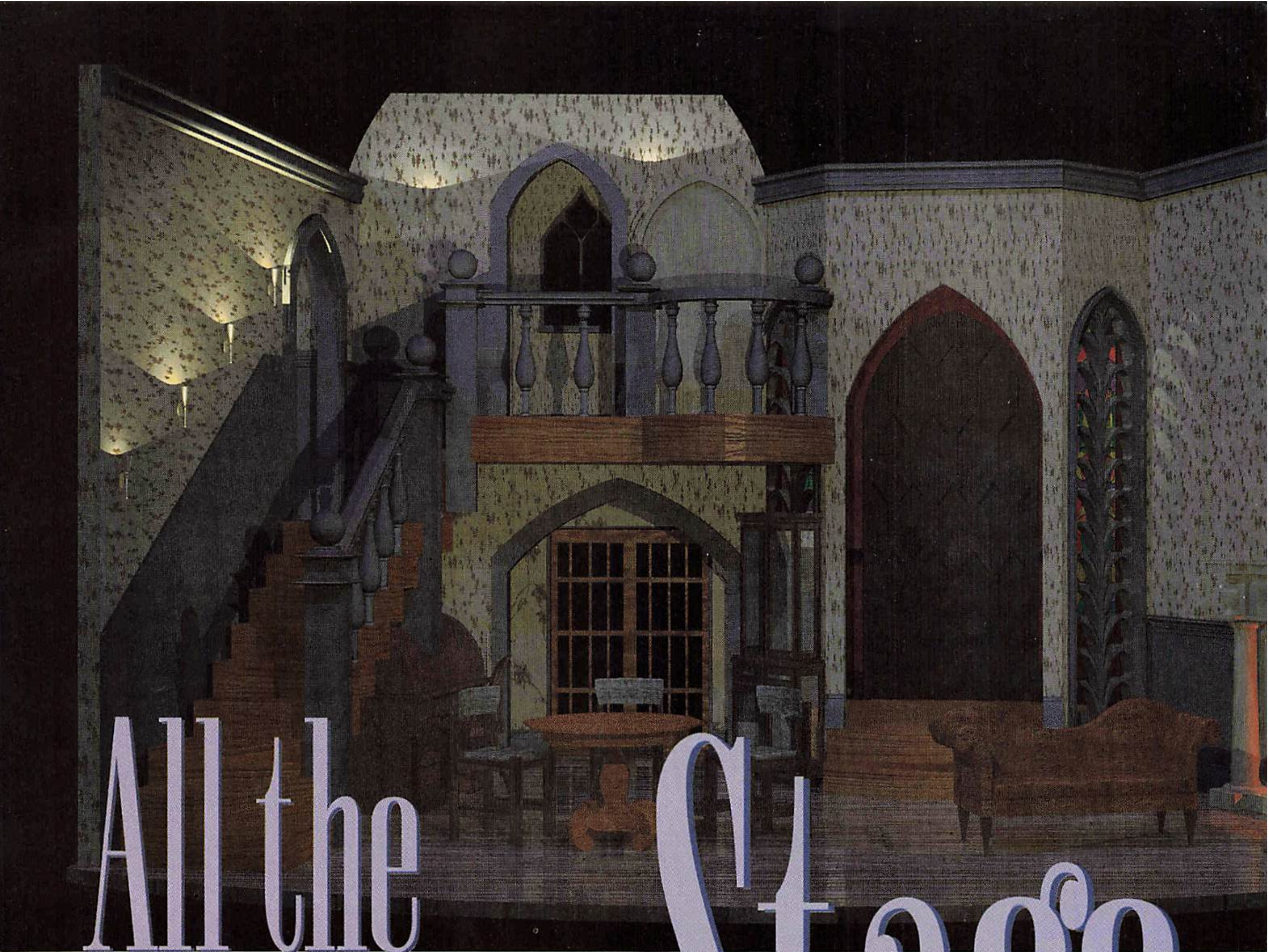
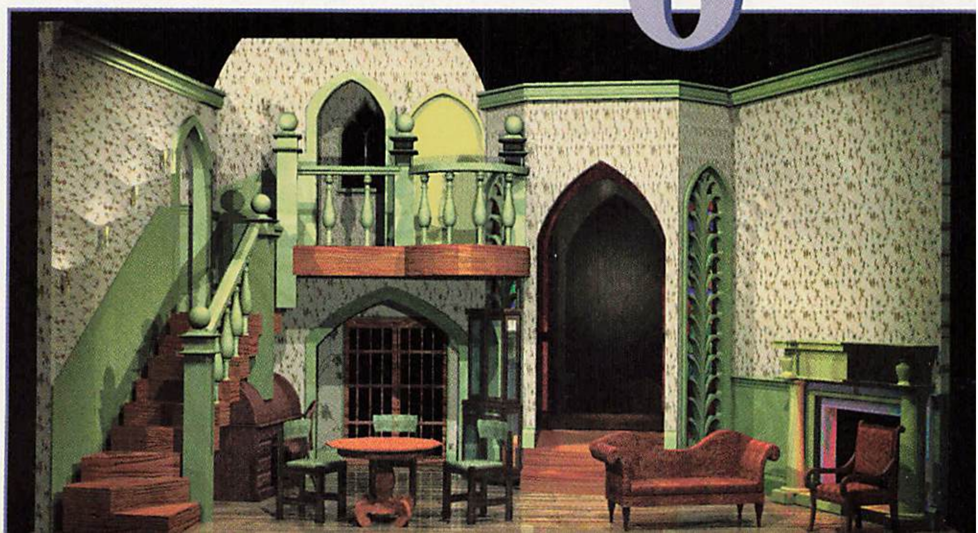
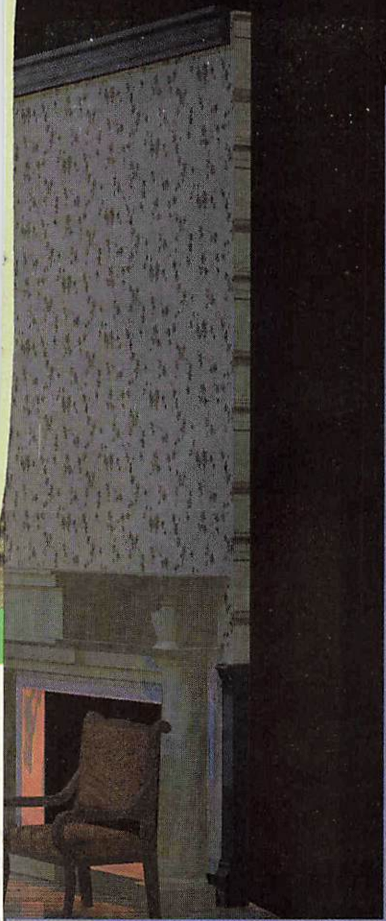


All the World's a Stage

Theatrical lighting concepts every 3D artist should know.

by Adam Watkins





Stage lighting is one of traditional theater's most powerful tools. It directs the audience's attention gently to make them see, understand, and feel things that they wouldn't on a flatly lit stage. Some of the best lighting designs aren't even noticed consciously, but operate subliminally. For instance, lighting alone can communicate the time of day. The audience will know the actors are outdoors at mid-afternoon, but they'll be hard-pressed to say how they know it. On the other hand, blatant use of visible light bearing down on an actor is one of the most powerful ways to communicate abstract situations such as inquisition, exposition, and isolation. The best lighting designs often involve a clever mix of the subliminal and the obvious; intensely colored lights to communicate heat, cold, and pain, for instance, and soft lighting to reinforce details of costume and set.

The same principles hold true on the virtual stage of a 3D content creation program. In fact, today's tools provide virtually every aspect of stage lighting, not to mention virtually unlimited freedom to add, position, and move lights. Due to the correspondence between theatrical and 3D tools,

familiarity with theatrical lighting techniques can be a huge help to 3D artists and animators.

The flexibility of the virtual environment to portray scenes that span the gamut from photorealistic to phantasmagoric can make virtual lighting issues even more pressing than those faced by theatrical lighting designers. How do you create the impression of daytime in a dark virtual world? How do you portray nighttime darkness and still allow the audience to see the action? How do you light a scene that take place underwater, in the forest, in the desert, in Heaven, in Hell?

Early in my training as a theatrical lighting designer, I read a comment by lighting guru Tharon Musser: "If you ask most people who tell you they want to be lighting designers what kind of weather we're having—what's it like outside?—half of them won't know how to describe it, if they remember it at all. They simply don't know how to see." The more time I spend with 3D, the more I realize that knowing how to see is as fundamental onscreen as it is onstage. Like theatrical lighting designers, 3D artists and animators must decide what is to be seen, how well it is to be seen, what sort of mood it is to suggest, when it takes place, and where it takes place.

Over the years, theatrical lighting designers have developed a body of techniques that can be applied directly in a 3D environment to communicate these and other critical aspects of a story. If you study them closely and apply them with care and imagination, you'll reap the reward of a more attentive, more involved, more emotionally committed audience.

Controlling Light J. Michael Gillette, a professional lighting designer and teacher, argues that a lighting designer can see the solutions to stage lighting problems "only if he or she has an understanding of the controllable qualities of the medium." If you understand these qualities, you can shape their role in your work. Furthermore, being able to articulate these qualities makes it easier to communicate with artists and animators who may be collaborating on your projects. Gillette identifies the controllable qualities of light as *distribution*, *intensity*, *movement*, and *color*.

Distribution. Distribution is a fairly broad term that includes the angle from which a light hits an object, the shape and size of objects covered by the light, and the quality of the light; that is, its diffusion or clarity.

Diffusion refers to how hard-edged a light appears to be, both on the object it illuminates and (in an aspect especially relevant to virtual lighting) in its volumetric opacity. The diffusion in Figure 1A, for example, is much less than in Figure 1B.

Global light sources (those without a readily identifiable location, providing a general angled wash over an entire scene) typically don't deal with diffusion. However, spotlights deal with it heavily. When creating a virtual spotlight, you can determine many qualities of distribution in the form of hard or soft edges and volumetric lighting (according to your particular 3D application).

Intensity. This refers to a light's brightness. The amount can range from total darkness to painfully

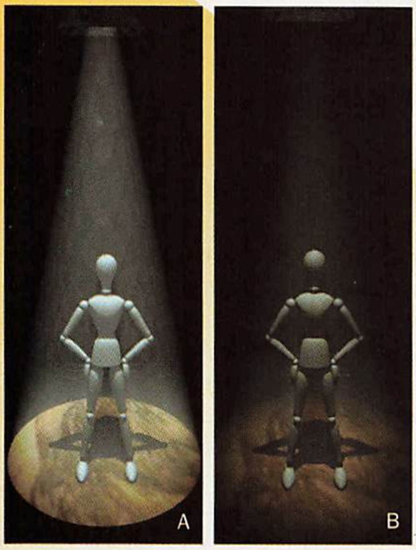


FIGURE 1. Lighting with low diffusion is hard-edged and/or volumetric (A). These features are less apparent in light with high diffusion (B).

FIGURE 2. Unlike global and ambient lights (A), spotlights offer the control over angle, area, and other fine details of distribution (B).

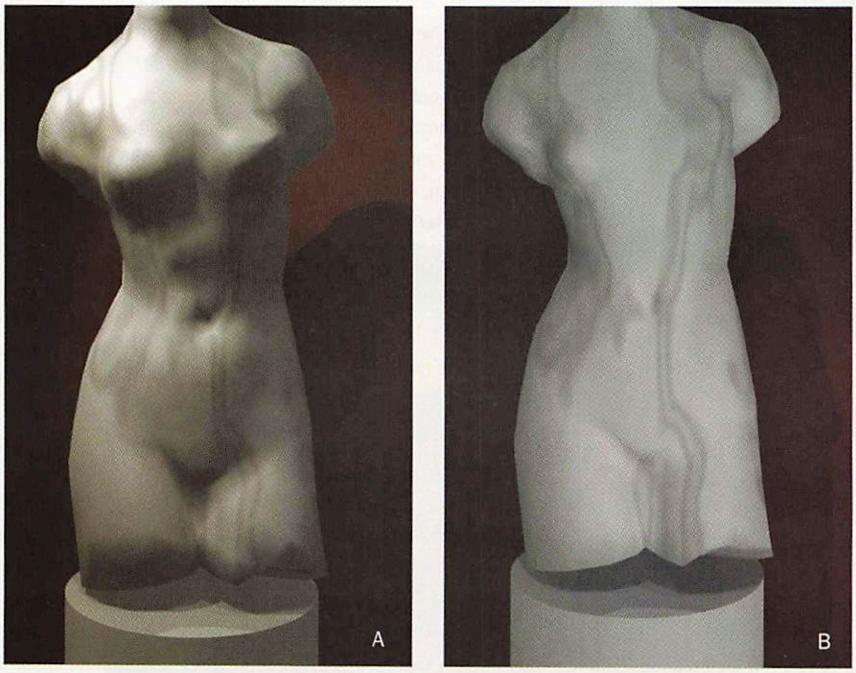


FIGURE 3. Careful distribution of shadows creates good modeling, or definition of form (A). Too much light from too many angles leaves the same object looking relatively shapeless (B).

piercing bright light. The typical default 80 percent intensity of many 3D programs falls in the upper middle range of the intensity spectrum.

Movement. In 3D animation, given the amount of control you have over lighting instruments, movement has several meanings. The word refers to the duration of light cues (rising or falling intensity), motion of scene lights (a carried lantern, falling lamp, or glowing eyeballs), and motion of lights that affect a scene but have no visible source, including point lights (light bulbs and the like). However, any kind of change in lighting parameters over time falls into this category.

Color. An extremely powerful tool, tinted light can convey information, solicit emotion, and catalyze a reaction. We'll look further into the use of color in a moment.

Lighting Functions In addition to understanding the qualities of light, it's important to define the functions of lighting design. In creating a lighting design, you must be concerned with *visibility*, *modeling*, and *mood*.

Visibility. This, of course, is the most obvious function of lighting, determined by the number of lights, their intensity, and direction. In the theater there's a saying, "if you can't see 'em, you can't hear 'em." This is true in 3D scenes as well. A scene must be seen to be believed, understood, and enjoyed. Lighting must make every relevant object or character clearly visible.

However, the very idea of controlled lighting suggests that objects are to be seen only as you want them to be seen. The main challenge of achieving visibility is to direct the viewer's attention to important areas and objects in a subtle way, a technique known as selective focus. Selective focus is based on an audience's instinctive reaction to light: most people look toward the brightest area. Moreover, selective visibility can hide shortcomings of modeling, animation, texturing, and so on.

Consequently, global lights, although they yield high overall visibility, usually aren't the best choice from the standpoint of lighting design. They tend to illuminate an entire scene equally, detracting from your ability to achieve selective focus. Often, I delete global lights entirely along with all ambient light, and instead use spotlights. Spotlights offer control over angle, area, and other fine details of distribution. The effect leaves much more to the audience's imagination, making the image more engaging (Figure 2).

Modeling. In lighting nomenclature, modeling refers to the visual definition of form. Good modeling provides enough light for visibility, but creates shadows sufficient to com-

municate object's form (Figure 3). Too much light from too many angles robs an object of the shadows needed to communicate its form—this is bad modeling.

If you've ever looked at a snapshot of yourself and found yourself staring at a stranger's face, you're familiar with the issue. The perpendicular angle at which a camera's strobe bulb sends out light obliterates shadows around the eyes, under the nose, and below the cheekbones, making it impossible to discern facial details. Even worse is when painstakingly constructed 3D models look washed out, flat, and uninteresting due to poor lighting.

Mood. Portraying mood (happy, sad, scary, triumphant, and so on) is one of the easiest lighting functions to achieve. Paradoxically, it also can be one of the most difficult when you're after a subtle effect. It may be fun to create breathtaking lens flares, volumetric lighting, and explosive special effects, but less obvious moods are the ones usually needed most, and the ones most often neglected in visually mediocre 3D scenes.

Fulfilling the Functions Having established the goals of effective lighting, let's dive into the specifics of how to make them happen. In his classic book *A Method of Lighting the Stage*, Stanley MacCandless, a professor of lighting at Yale, describes how to use the qualities of light to achieve the functions of light. MacCandless' theories have been applied in theatrical productions for years, and they're incredibly powerful applied to 3D.

Adapting ideas from traditional photography, MacCandless identifies two basic lighting types: key and fill. A key light is the brightest light aimed at the target object, while a fill light is much dimmer. Fill lights soften shadows left by the key light and add color and depth.

Arrangements of key and fill lights can be drawn in a diagram known as a key plot (Figure 4) A key plot shows where the key and fill lights are positioned and their angles; it can show color as well. A key plot is divided into top, front, and side views. Each light source is represented by an arrow that defines its angle. I've numbered them as well so it's easy to identify the same light in various views. Backlights usually appear only in the top and side views because their angle can't be communicated in the front view; similarly, sidelights usually don't appear in the side view. An arrow with a bent shaft, such as the rose light in the lower left and right areas of the plot, indicates a toplight; that is, a light positioned directly above the scene.

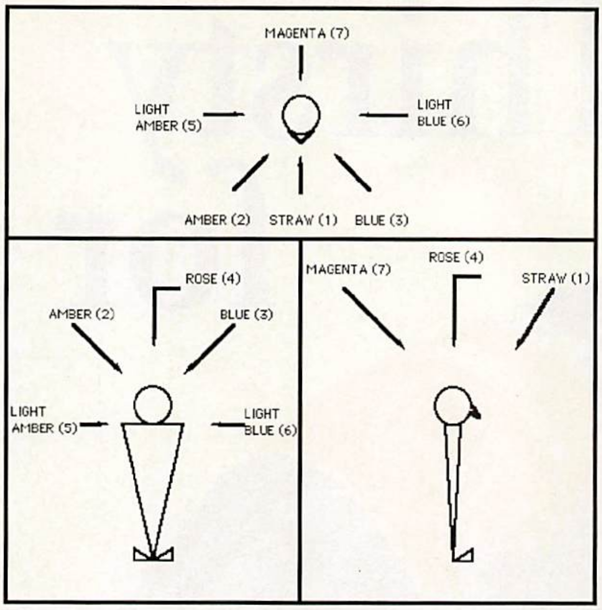
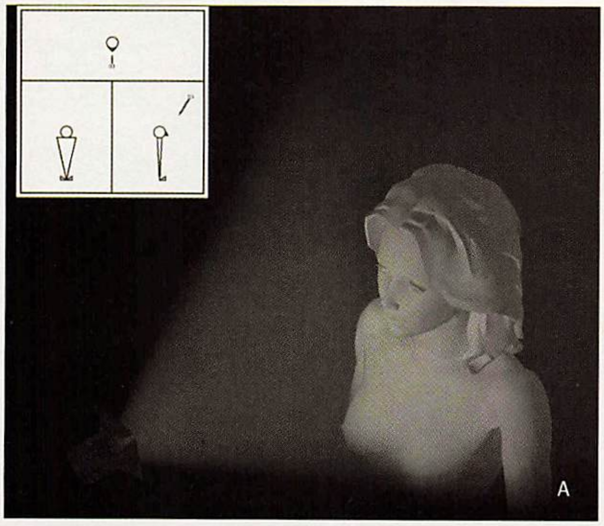


FIGURE 4. A key plot is a diagram that shows where the key and fill lights are positioned, their angles, and sometimes their colors. A key plot is divided into top, front, and side views. Each light source is represented by an arrow that defines its angle. In this illustration, each light is numbered to make it easy to identify the same light in various views.

Figure 5 illustrates how a key plot relates to a lighting setup, and the resulting rendered image. In this case, the key plot shows only a front light; no fill lights are present. The key plot in Figure 6 is much more complex—it includes one key light and four fill lights—and creates a more interesting rendered image. The key light generates a strong shadow across the left side of the face and bottom of the chin, adding definition to the form for good modeling, while the fill lights make it easy to see the object as whole.

Most theatrical lighting designers sketch several key plots for each scene before set-



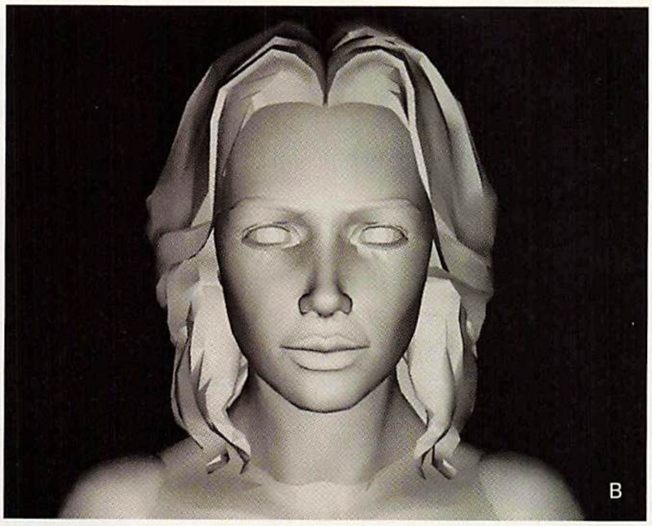


FIGURE 5. A key plot describes a lighting setup (A) and thus affects the quality of the resulting rendered image (B). This key plot shows only a front light; no fill lights are present.

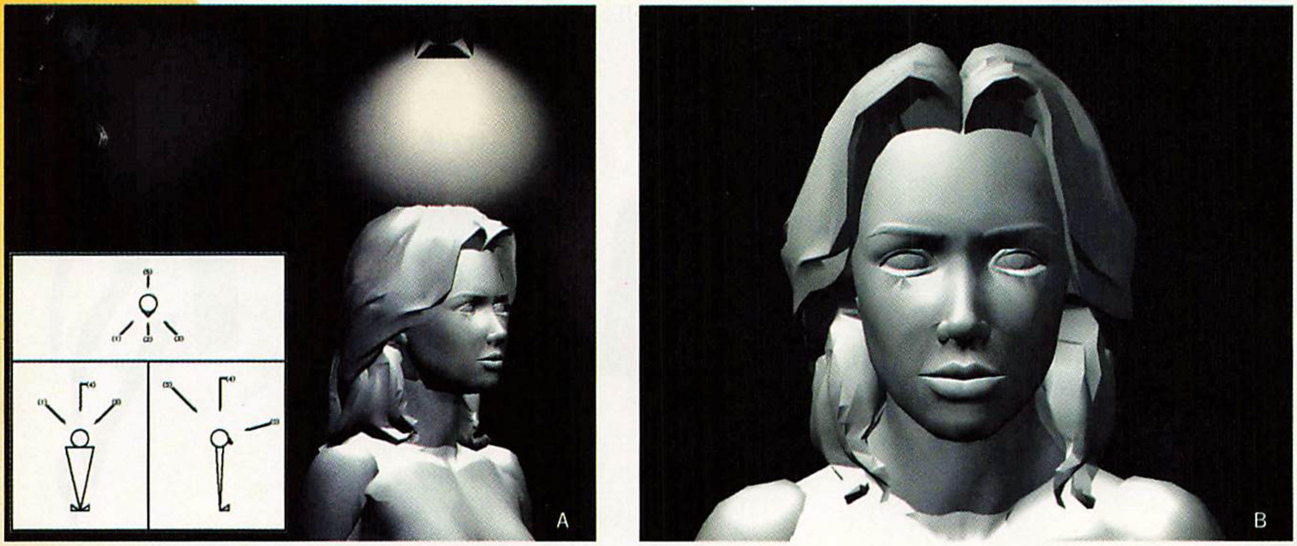


FIGURE 6. A complex key plot (A) creates a more interesting rendered image (B). The key light generates a strong shadow across the left side of the face and bottom of the chin, adding definition to the form for good modeling. The four fill lights, among them a toplight and a backlight, make it easy to see the object as whole.

tling on a design. Sketching out a key plot before you start placing lights and rendering can be a big time saver. A key plot doesn't deal with some important issues of virtual lighting, such as distribution, fall-off, or intensity, but it does help solidify a lighting design and locate weaknesses before you reach the production stage.

By default, most 3D applications open to an environment with high ambient light and a global light or two, providing a brightly lit space in which to model. While this definitely accomplishes the visibility requirement of lighting design, it's dull, flat, and uninspired. To make visibility an artistic aspect of a design, it's necessary to address the other functions of lighting design as well.

A Sharper Angle One of MacCandless' most powerful ideas is dynamic use of lighting angle. This is one of the most effective ways to communicate mood, time of day, and a host of other important ideas. Global lights, when angled well, can act like the sun and provide general lighting; however, for indoor scenes and more dramatic scenes, spotlights make a better choice.

Without any color and only one key light, angle alone creates dramatic effects. For instance, a heavy top light can denote mystery (Figure 7A), and a more oblique angle can denote ominous danger (Figure 7A). Light angles that don't occur naturally can make for a frightening effect (Figure 7C).

Multiple Lights A higher degree of realism can be achieved using multiple lights. Even outdoors, our everyday lives are illuminated by numerous light sources. The sun acts as the key light and then bounces off nearby glass, buildings, cars, and even cement floors. Indoors, the situation is similar. Every table, wall, and piece of furniture reflects light, and therefore counts as a fill light. The point is that, while an appropriately angled key light is critical, fill lights are necessary to flesh out the design.

Most of MacCandless' designs call for at least five light sources: toplight, backlight, two sidelights, and a combination of angled and straight frontlights. Any of these sources might be considered the key light while the others become fills.

I've seen effective outdoor scenes that used a combination of a global light as a key light (the sun) with several spotlights as fill (sunlight bouncing off surrounding surfaces). However, for indoor scenes, it's a good idea to stick to a point or spot light as the key (a light bulb) and use spotlights for

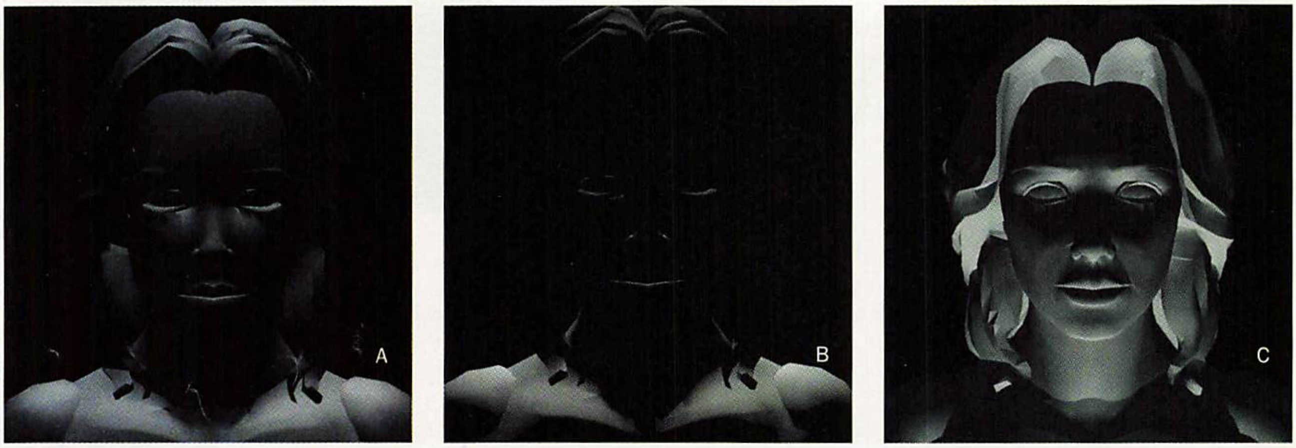
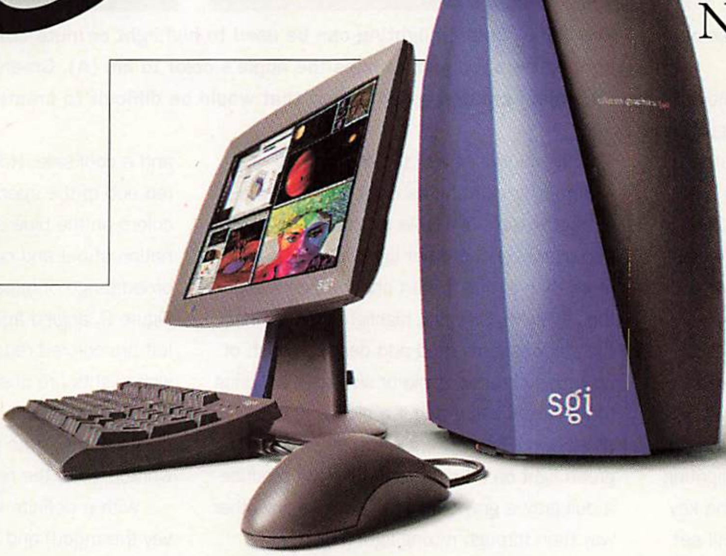


FIGURE 7. A single key light can create dramatically different depending on its angle. A heavy top light can denote mystery (A). Angle can denote ominous danger (B). Light angles that don't occur naturally can make for a frightening effect (C).

Wicked



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fill. This gives you a high degree of control over fall-off and distribution.

An important caveat when using multiple lights: If the key light isn't the brightest light in a scene or the fill lights are too intense, you can't achieve good modeling. Figures 3A and 3B (p. 54) depict the same key plot, but in Figure 3B the fill lights are set to a much higher intensity. The result is a washed-out scene devoid of shape and interest.

A similar outcome can occur if ambient light settings are too high. Ambient light provides too much light without an identifiable source or angle, diffusing other lights that may be selected and positioned effectively. Multiple light sources are important for realism, but they must be used sensitively and kept at a reasonably low intensity.

Color Enhancements In real life, light is rarely white. As it bounces off surrounding surfaces, it reflects their hues, resulting in a varied combination of colors. Virtual lighting should be no different. The color of the key light (as the strongest light source) will set the tone while others either complement or contrast with it.

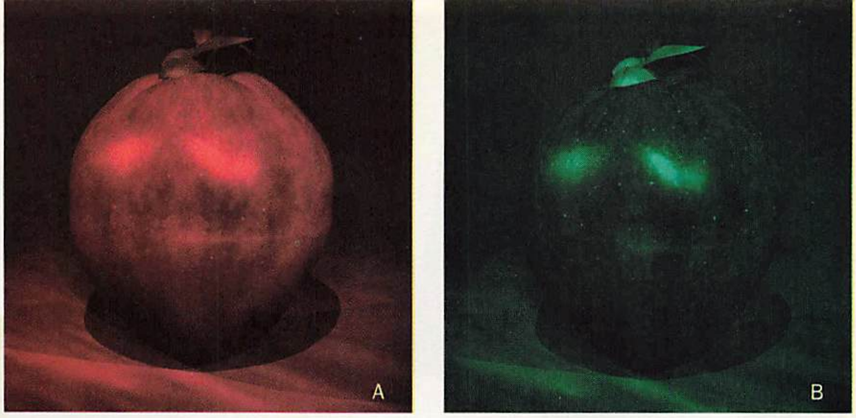

FIGURE 8. Colored lighting can be used to highlight or mute colors of objects. Red lighting on a red apple brings the apple's color to life (A). Green lighting on the same red object creates a dark effect that would be difficult to create any other way (B).

The color choice of the key light is extremely important, as color is one of the strongest tools available for conveying emotion. However, the other light sources can do more than simply soften shadows created by the key light. They can highlight colors, enrich the color scheme, and add depth. A dash of light rose on a red apple or skin tone will bring that color to life, giving it a glow and identity of its own (Figure 8A). On the other hand, a green light on a bright red apple will produce a dull gray, a gray difficult to achieve any other way than through mixing light (Figure 8B).

A popular technique in theatrical lighting is to divide an area to be lit into a hot side and a cool side. Hot refers to colors on the red end of the spectrum, while cool refers to colors on the blue end. Lighting with a combination of hot and cool colors brings out a broad range of hues in the object being lit. In Figure 9, angled front lights on the right and left are colored red and blue respectively; white lights are positioned back, top, and two in front (one of which is the key light). The colors of the lights are most apparent in the white area of the rendered result.

With a definite key color choice (to convey the mood) and subtly colored fill lights (a hot side and cool side relative to the object), you can retain a lot of control over mood

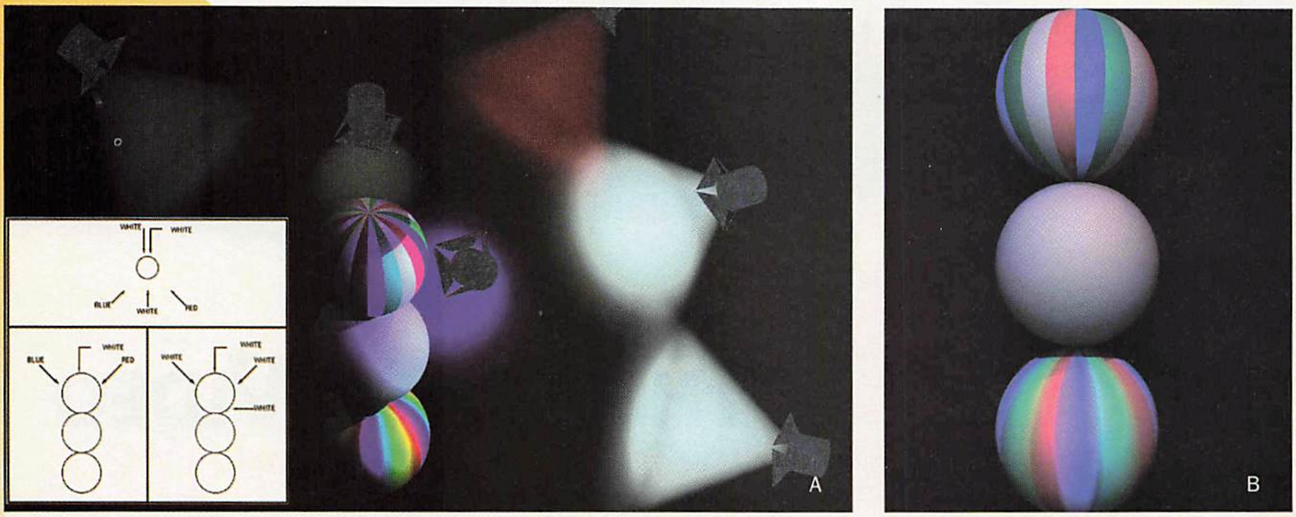

FIGURE 9. In the key plot for this lighting design (A), angled front lights on the right and left are colored red (hot) and blue (cool) respectively; white lights are positioned back, top, and two in front, one of which is the key light. The colors of the lights are most apparent in the white area of the rendered result (B).

while revealing all colors in the objects in the scene. In addition to bringing out colors, this approach adds a sense of depth that can't be achieved without colored lighting.

Putting It All Together We've talked about the controllable qualities of light; the functions of visibility, modeling, and mood; and the techniques of angle, multiple light sources, and use of colors. Putting them all together can have a dramatic impact on the presentation of scenes and individual objects alike.

You can see how these theories can enhance a scene in Figure 10, a virtual set design for a production of *Pools Paradise*. Figure 10A is poorly lit; it has multiple lights, but they're all the same strength. They don't enhance mood or modeling, just visibility. Figure 10B is the same set with lighting that denotes a happy setting; notice how much


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more colorful the wallpaper looks and how much more depth the space has. Several of the fill lights are yellow (a major color in this set design), highlighting the colors of the set, with a hot side/cool side scheme that gives the image increased depth. Figure 10C is lit to portray a nighttime setting with a more sinister mood. Again, the lighting creates good visibility (perhaps more than necessary in many 3D scenes), but it still looks as though the lights are off and something vaguely threatening is afoot. Cool blue lights shining on the yellow set provide good visibility, but the unsaturated colors (as colors appear under little light) give the impression of relative darkness.

Applied to an individual object, the principles of theatrical lighting can create a dramatic emotional impact. Color can easily create diverse and powerful moods, as illustrated in Figure 11. Note the key plot for each image, and the colors and angles used to communicate each mood. Note also the depth and vibrancy of these images compared with the black-and-white renderings in Figure 7.

Drawing key plots, positioning multiple light sources, and selecting an optimal color for each can take time. Moreover, different 3D applications and rendering engines handle color and shadows in different ways. Thus, it might be a little difficult to sort out the methods described in this article within the your tool of choice. However, as you experiment with them, the concepts presented here will become more concrete, and soon you'll find combinations that work effectively for your application. At that point, you'll find that implementing them becomes faster and more efficient. The results will speak for themselves.

FIGURE 10. Three views of the same scene. One is poorly lit (A) with several lights of the same strength. One well lit for a happy setting (B) in which several yellow fill lights highlight the colors of the set and the hot/cool-side scheme enhances depth. The third is lit for a nighttime setting (C) in which blue lights shining on the yellow set provide good visibility, but the unsaturated colors give the impression of relative darkness.

Adam Watkins is a graduate student at Utah State University pursuing an MFA in Art. With the longsuffering help of his wife Kirsten and under the guidance of Professor Alan Hashimoto, he is working toward the goal of teaching 3D modeling, lighting, and animation. Email him at awatkins@cc.usu.edu.

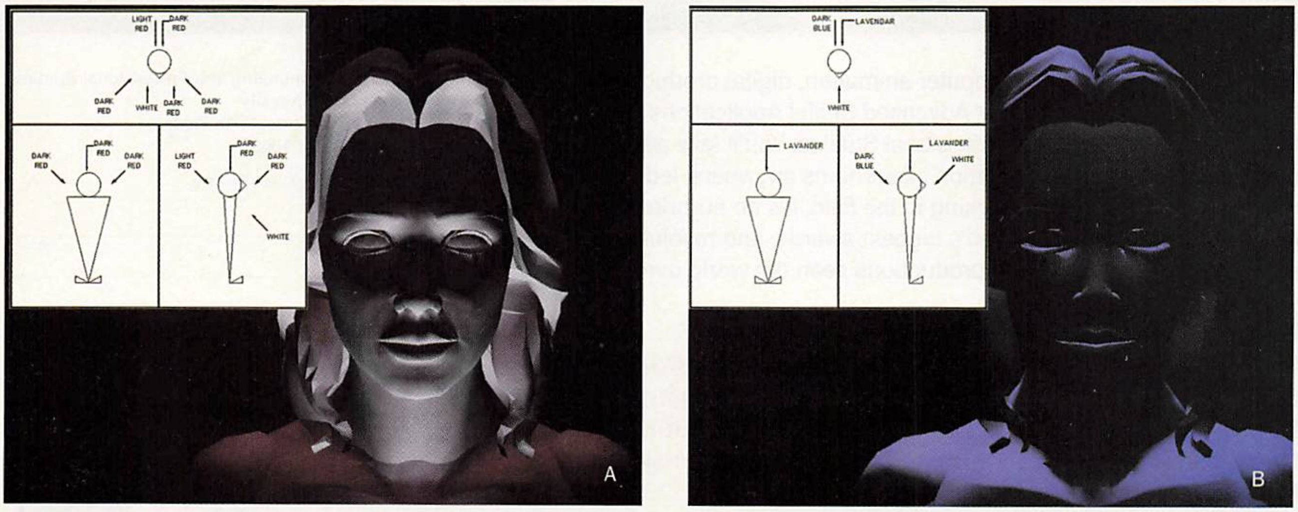
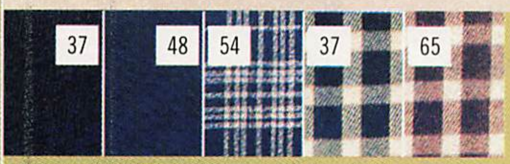


FIGURE 11. Applied to an individual object, the principles of theatrical lighting can create powerful moods such as frightening (A) or mysterious (B). Note the key plot for each image, and the colors and angles used to communicate each mood.



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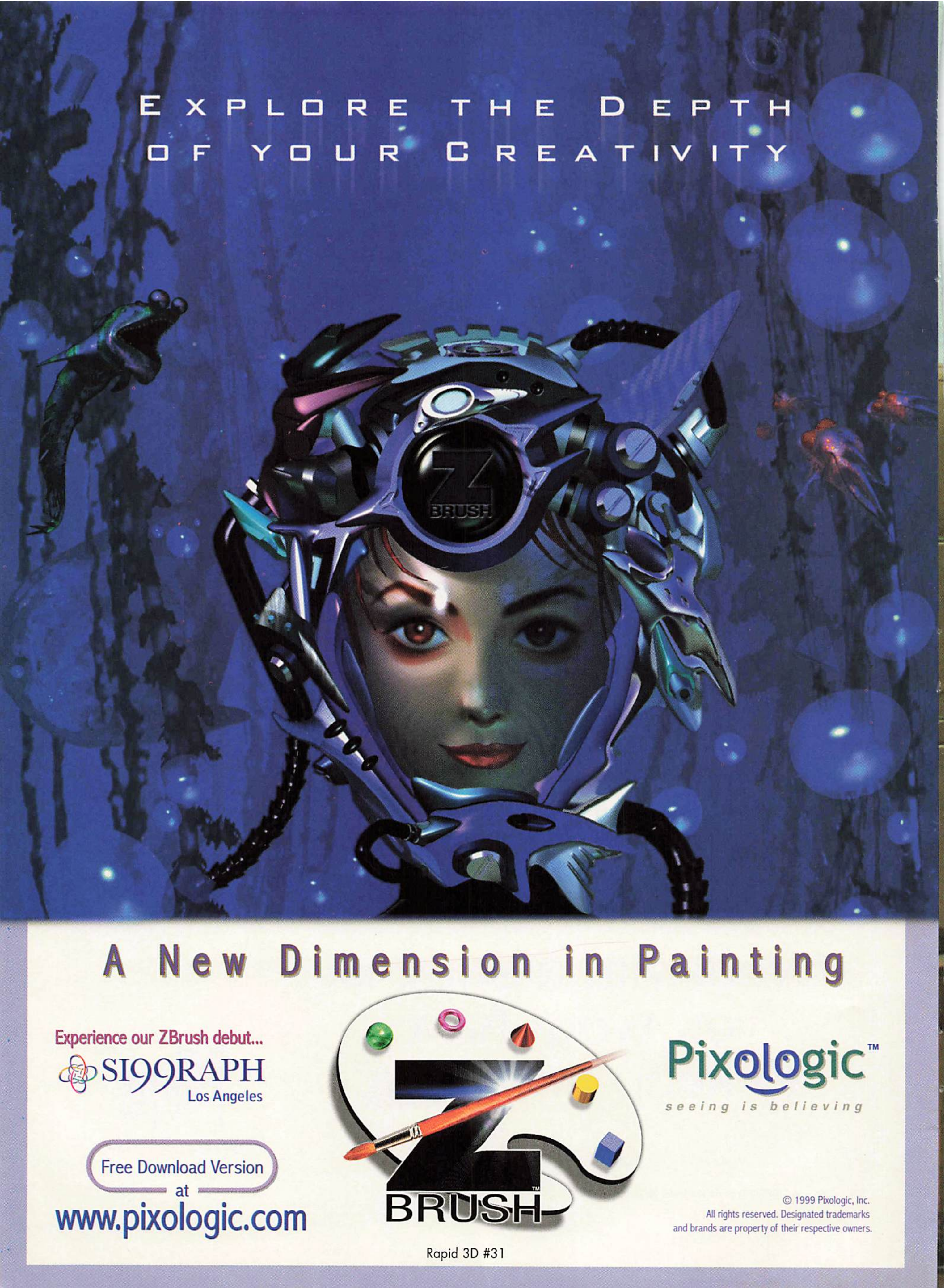
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Rapid 3D #31

BY PAUL DAVIES

Step into a Photograph

MetaCreations Canoma 1.0

Canoma is described by MetaCreations as "the first product that allows users to quickly create photorealistic 3D content from scanned or digital photographs without extensive 3D skills." The last four words are essential to the claim of being first, and having spent time playing with Canoma 1.0 and having gone through the tutorials, I can attest that it does the job easily and can also create flythrough animations of 3D scenes derived from 2D images. What I'm less sure about is how many 3D artists and animators will find it useful. MetaCreations identifies its target as 3D designers and animators, 2D designers, and web content creators, but I think it's actually a subset of this demographic.

Getting started with Canoma was very easy. I installed it on my dual-300MHz Pentium Pro on Windows 95; it ran on Windows NT without a second installation. The user interface (Figure 1) sports an aesthetically pleasing design that marks it as the work of MetaCreations' Kai's Power Tools crew. Its subtle gradients and fading highlight states look great on a 24-bit display, but they don't fare as well in 16-bit color.

The basic technique involves importing a 2D image, matching 3D primitives to areas in the image, and automatically texture-mapping the primitives with pixels drawn from the image. Canoma is best suited for matching hard-edged rectilinear forms such as buildings and simple furniture. The process involves loading one of several primitive forms, via buttons that line the lower edge of the GUI, and pinning its corners to those of the object in the image (Figure 2). As you align corners, Canoma positions its virtual camera and adjusts the focal length to match the perspective in the photo automatically. If this doesn't sound impressive to you, it may be because you've never tried matching geometry and camera settings to a photograph by hand. In this respect, MetaCreations Canoma is amazing, simplifying a difficult task. There are even tools to help you align

FIGURE 1. Canoma's user interface is in the customary MetaCreations style. Bryce and KPT fans will feel right at home; users of mainstream 3D content creation apps might find it awkward.

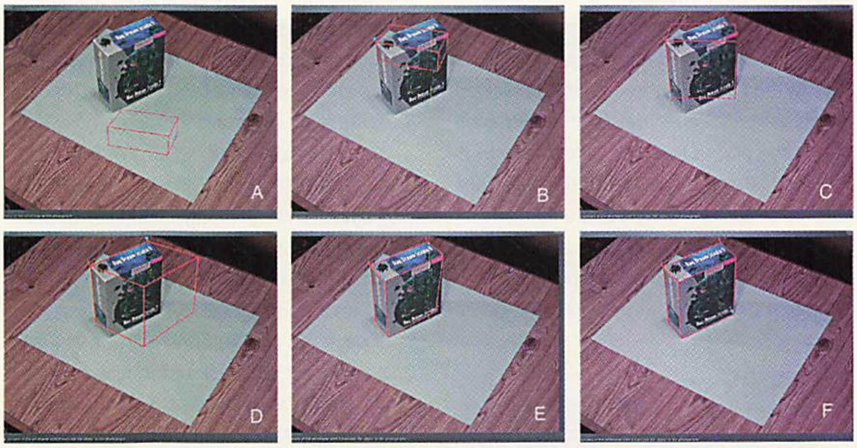

FIGURE 2. After selecting a primitive from the lower edge of the user interface (A), you pin the corners one by one, matching them to corners of an analogous object in the image (B-F). Canoma adjusts the 3D camera's position, orientation, and focal length based on the primitive's new position.

primitives to items whose corners lie outside the borders of the imported image.

I was most impressed by Canoma's ability to extract and flatten appropriate portions of a photo and apply them as textures (Figure 3, p. 68). Once you're satisfied with your pinning, you just click a button and Canoma will create and apply textures for every visible surface on the primitives. Multiple photos of an object taken from various angles and

distances can be used to generate textures for hidden portions of a model. If you don't have several images to work from, Canoma can perform a clever texture-mirroring trick to fill in the blank spots.

To create a flythrough animation of your geometry, you simply advance to the appropriate frame using the timeline slider, position the camera, and set a key. When you're done setting keys, you can play back the animation in Canoma or export it as a QuickTime movie. The procedure is simple enough, but Canoma lacks a quad view, making it difficult to fine-tune camera motion (especially if the camera rotates more than 90 degrees on an axis). Moreover, Canoma doesn't provide any controls for configuring QuickTime output other than resolution. If you're fortunate enough to have one of the few 3D programs for which Canoma can export textured models (more on this in a moment), you'll probably want to create your animations there.

The tutorials are comprehensible but somewhat inconsistent. Some procedures are explained in detail while others are rather sketchy. Sometimes the instructions seem to omit portions of steps. Though it was rarely difficult to figure out what needed to be done, the omissions seemed unnecessary.

The most frustrating experience I had came late in the tutorials. The tutorial contained a procedure for aligning and connecting multiple primitives using Canoma's Glue tool. To the best of my knowledge, I followed the steps to the letter; yet when I attempted to glue the pieces together, things went terribly wrong. The geometry started to twist and warp as Canoma attempted to understand the connections I'd made (Figure 4). It was only later, in the "Advanced Modeling" reference, that I learned that this behavior meant

sources

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- **MACINTOSH: PowerPC, MacOS 8 or greater, 32MB RAM, 50MB hard disk space, CD-ROM (for installation), 24-bit color.**

SEE RAPID 3D GUIDE ON P. 95.

Canoma didn't understand how I wanted my primitives to be attached to each other. Armed with this knowledge, I returned to the task at hand. As suggested by the reference materials, I attempted to glue the pieces in various ways. After several unsuccessful attempts, I finally threw in the towel. This was the only real difficulty I encountered.

On the other hand, an insistence on entry-level simplicity is Canoma's biggest weakness. The feature set is too limited for serious work. There are no spheres, hemispheres, or cylinders in Canoma's list of primitives. In all likelihood, such forms would be far more difficult to pin accurately, but that doesn't keep me from wanting them in Canoma.

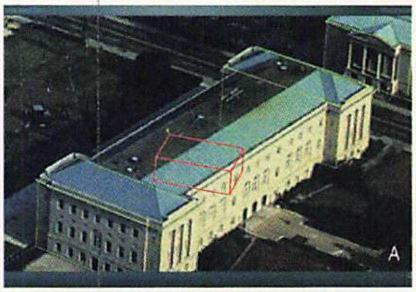
A polyline tool extends the range of 3D shapes beyond the selection of primitives by letting you extrude user-defined shapes. With careful texturing, polyline objects are handy for cars, trees, people, and other asymmetrical shapes—but they'll only get you so far.

The bottom line is that Canoma isn't designed for high accuracy. For instance, there seems to be no way to set size and orientation values numerically. Although Canoma's WYSIWYG approach works, it would be a lot more powerful if you could enter measurements gathered from location surveys, or at least set a scale for object export.

Canoma can import JPEG, TIFF with alpha, PNG with alpha, GIF with alpha, PSD with alpha, BMP (Win only), and PICT (Mac only)—but no 3D formats. Export formats include MetaStream (MetaCreations' own web-friendly format), OBJ, VRML 2, Caligari trueSpace 3D, and AutoCAD DXF, as well as QuickTime 3.0. The lack of formats such as Softimage, NewTek LightWave, and Discreet 3D Studio MAX indicates that MetaCreations doesn't expect the Canoma user base to extend into the higher end software market. This is a shame, since Canoma seems well suited to pre-visualization work and virtual set creation (such as Manex did for the "flo-mo" shots in *The Matrix*).

The documentation goes to the trouble of outlining which aspects of the supported formats can be utilized in unsupported packages. This certainly can save a bit of time

FIGURE 3. Starting with a 2D image (A), Canoma can extract and perspective-correct a portion for use as a texture map (B). The blurred area in the lower left corner of image B was created by the software to fill the portion that doesn't appear in the original image.



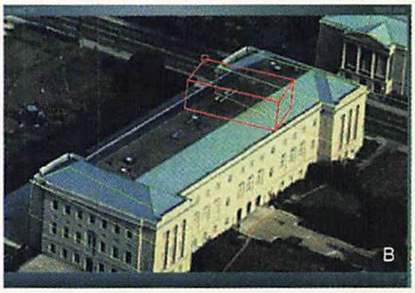


FIGURE 4. In an attempt to use the Glue tool to align and connect multiple primitives, I started with a pair of boxes properly aligned to the imported image (A). But when I glued the pieces together, the geometry started to twist and warp (B).

and frustration, yet it makes me wonder why the program doesn't support some of the more popular formats directly. The suggested retail price, $499, is only $100 less than that of Caligari trueSpace and $200 more than MetaCreations' own Ray Dream Studio.

Given Canoma's extraordinary capabilities and limited feature set, I think it might find a niche market (although a lower price would help). However, with more primitives, measuring tools, and 3D file format support, Canoma would be an exceptional tool for a wide variety of users. As it currently stands, it may be inaccessible to those who would appreciate it the most.

Paul Davies started his career as an illustrator. Currently, he is a 3D modeler and texturer for Lucas Arts. Contact him at pdavies@lucasarts.com.

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BY RICHARD LAINHART

Very Special Effects

Puffin Designs Commotion 2.0 for Mac

"Photoshop for video" is how people often refer to Commotion from Puffin Designs. Even if you don't know about the program's 2D animation, paint, and rotoscoping capabilities, you've seen them in action in films such as *Star Wars Episode 1: The Phantom Menace*, *Pleasantville*, *Mighty Joe Young*, and *Dr. Doolittle*. Scott Squires, Academy Award-winning founder of Puffin Designs, works at Industrial Light & Magic (ILM) as a visual effects supervisor, along with quite a few other Puffin employees. In fact, Commotion was used internally at ILM for years before its commercial release.

Commotion 1.0 has proven invaluable to the 3D special effects community, and version 2.0 ($2,495) offers even more features that make it worthwhile to anyone who works with 3D rendering and animation. Let's take a look at the new release with an emphasis on features of special interest to 3D artists and animators.

By the time you read this, Puffin should be shipping Commotion 2.1 for Mac and the much-anticipated Commotion for NT, also version 2.1. Except for differences in keyboard commands and other platform-specific functions, the two versions are said to be identical and are expected to maintain feature parity in future releases.

Real-time Playback Commotion is designed first and foremost for viewing and painting or matting full-motion film and video frames. Among its many unique attributes, it was the first desktop application that could play back full-resolution uncompressed video in real time on a basic platform with no additional hardware, something that since has become relatively common in Mac- and NT-based compositing and special effects programs. To accomplish this, Commotion loads frames for playback into RAM, which means that you need a lot of RAM to play back clips of any length. An uncompressed video-res frame with an alpha channel consumes about 1.3MB of RAM; one second of D1 video requires more than 40MB of RAM beyond what Commotion requires for itself. 500MB of RAM isn't excessive when it comes to Commotion.

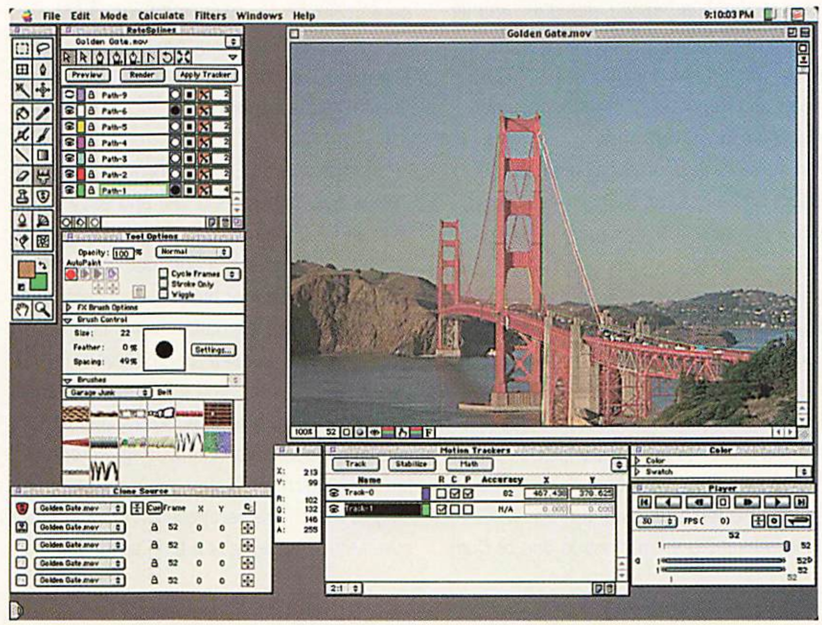

FIGURE 1. If you know Photoshop, Commotion's interface and tools will seem familiar.

Commotion's hardware requirements are equally heavy. You'll need a PowerPC Macintosh running MacOS 8, a fast video card, at least 100MB of RAM, fast drives for loading and saving clips, and, ideally, a pressure-sensitive graphics tablet. (The upcoming NT version will require NT 4.0, a Pentium processor, 128MB of RAM, and QuickTime 4.) Fortunately, the graphics performance of new Macintosh systems, including G3 PowerBooks, has gotten much better lately, and a standard G3 desktop Mac is perfectly viable for Commotion. In fact, a current G3 PowerBook can play back D1-resolution video clips at nearly 60fps and film-res clips nearly in real time. You can stuff up to 512MB of RAM into the latest models, so it's actually feasible to do special effects work at the beach. (Be sure to keep the sand out of your keyboard and drive bays, though.)

Obviously, the ability to play back animations is valuable to 3D animators. Before software-based playback engines like Commotion, you had to compress them for playback using a hardware video system, send the files off to a post house for an expensive layoff to tape, or content yourself with low-res previews. Commotion makes all of this unnecessary by letting you see renders in real time on your desktop, and many users will find that it pays for itself with that feature alone. If all you need is playback, by the way, Puffin offers a Commotion Player for Mac and NT for roughly $250 that gives you the playback engine without the ability to modify clips.

Paint If you're familiar with Photoshop, you'll notice that Commotion's user interface and tools look a lot like it (Figure 1). Commotion's paint tools include the usual brush, airbrush, paintbucket, rubber stamp, blur, sharpen, eraser, line, and gradient options, along with the unique SuperClone brush, which lets you clone pixels from any open clip to another. The wire removal tool, another Commotion first, lets you seam adjacent pixels over a wire harness or other rigging, or clone from one clip to another, much like the SuperClone brush. You can also record paint strokes with any of the brushes

and play them back over multiple frames, or AutoPaint recorded strokes progressively over the length of an animation.

Version 2.0 adds the FX Brush, which lets you use any image as a brush source and provides extensive support for varying the brush with pressure, speed, direction, and tilt functions of a Wacom Intuos pen (Figure 2). The new version also includes multiple undos for paint and rotoscoping operations, sorely lacking in previous versions.

No software is perfect, 3D programs included, and all too often they render weird results—polygons flipping around, textures bubbling, whole objects disappearing and reappearing. If you have the time and ability to figure out and correct the problem and rerender the sequence, this isn't such a big problem. In production, though, you rarely have that luxury. With Commotion, it's much faster and easier to repaint the flipped polys, clone the offending texture, or SuperClone the missing objects from other frames.

Retouching 3D animations is one of Commotion's most important functions. In fact, it's rumored that nearly every frame in *The Phantom Menace* was touched by Commotion in some way, from fixing render problems to rotoscoped removal of characters from one location and insertion into another to pure scene enhancement. This kind of obsession with seemingly mundane detail can make the difference between a good production and a superb one.

Motion Tracking Commotion's motion tracker has always been fast and easy to use, and 2.0 improves it. The motion tracker lets you stabilize shots automatically or track four points for corner pinning—applying motion-tracking information to the corners of a 2D image to simulate perspective in 3D space. For instance, you might track an advertisement on the side of a moving bus and paste a client's logo over it using the corner pin filter, which will distort the logo automatically to match the perspective of the moving bus. Motion tracking is a time saver when

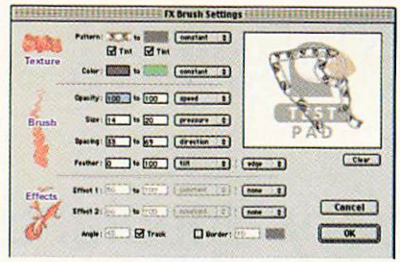

FIGURE 2. With the FX Brush, you can use any image as a brush source, plus it supports the Wacom Intuos tablet.

combined with AutoPainting. You can track an object in a scene, attach the tracking data to a SuperClone brush, and use AutoPaint to clone the object out of the scene automatically, potentially saving hours of work.

Animators using Play Electric Image can take advantage of Commotion's new 3D Pan & Tilt motion tracking, which can follow a moving object and export the tracking data as pan-and-tilt data you can attach to a camera in Electric Image. Thus, you can match the motion of a camera in a 3D scene to the that of the camera that shot the original footage—an invaluable tool when trying to integrate moving 2D and 3D imagery. Even if you don't use Electric Image, if your software lets you apply motion-capture data to camera position and rotation, you should be able to take advantage this feature.

Rotosplines & Matte Making Rotoscoping usually often involves tracing around live-action characters to create mattes for compositing the characters against a new background. It's standard practice to shoot characters intended for compositing against a bluescreen or greenscreen, but sometimes this isn't possible. Or sometimes the director changes his or her mind and wants the characters in a different location after they've been shot. As you can imagine, tracing a character in every frame of a shot, possibly over hundreds or even thousands of frames, can be extremely tedious and labor-intensive. Commotion is a superb rotoscoper, and its rotosplines and matte retouching tools, combined with the ability to apply motion-tracking data to rotosplines, make this kind of work much more manageable.

A rotospline is an animatable Bezier or B-spline path drawn using the pen tool; Commotion lets you create an unlimited number of rotosplines in a clip. You start by tracing the outlines of the object you want to matte out, then you move forward a few frames and move points around the outline to match the object's new position. You continue setting

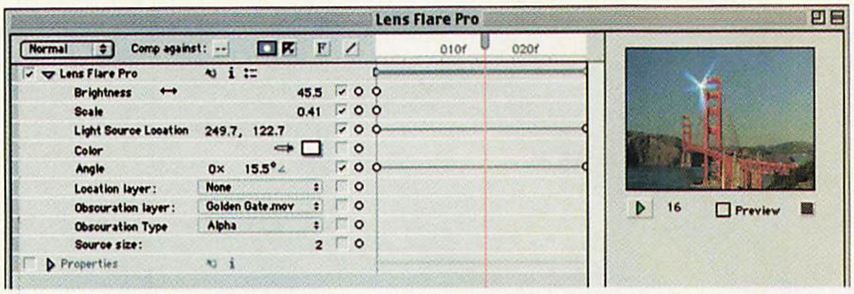

FIGURE 3. The time line makes it easy to animate After Effects filter settings over time, and you can preview the effect in the thumbnail window.

keyframes for the rotospline (or splines) until the object is completely rotoed. If the object has a stable outline, like that of a car viewed from the side, you can often motion-track it and apply the data to the rotospline's position; this makes the matting process incredibly easy. Then you can render the resulting matte into the clip's alpha channel or as a separate file for compositing in another program.

If you just need to composite the object you've rotoed against a single background layer, Commotion's own Composite function, which supports foreground, background, and matte layers, will do the job. This is a fast, easy way to composite 3D animations with alpha channels into video or film footage.

Filters & Motion Text Commotion 2.0 now supports third-party Adobe After Effects filters, along with QuickTime 3.0 and 4.0 effects. It comes bundled with a new set of ICE image-processing filters, which owners of BlueICE accelerator hardware can run at greatly accelerated speeds on their hardware. To support keyframing the filters, Puffin has implemented an elegant time line that makes it easy to animate filter settings over time (Figure 3). The filter dialog also lets you preview an effect in a thumbnail window before applying it, an ingenious and welcome feature.

Commotion's extensive tablet support includes the ability to slide parameter values by dragging the cursor over a value, so you don't have to drop the pen and go to the keyboard. The new time line interface does this feature one better with Rub Text, which lets you scrub filter values by dragging over the value's name, and even lets you change X and Y values simultaneously with a nifty double-arrow cursor.

Commotion 2.0 also includes a new Motion Text plug-in similar to After Effects' PathText filter, with animatable tracking, leading, and Bezier motion paths and a built-in drop shadow that doesn't look half bad. You can also add a true directional motion blur to the moving text, which, along with the new filter effects, can create reasonably sophisticated text titles.

Upstanding Upgrade Commotion is coming closer and closer to competing directly with Adobe After Effects (AE), the market leader in desktop compositing software. New features such as third-party filter support, FX brushes, and motion text are starting to make Commotion a compelling alternative to After Effects, which lacks paint functions, for example. The two programs also work well together, and until Commotion provides complete multilayer support, it can't replace AE.

If you don't do a lot of multilayer compositing, Commotion might serve as your only 2D program. Its superb retouching and image-enhancement capabilities could make the crucial difference between breezing through a tight deadline and settling for less than you had hoped for.

Richard Lainhart is digital media specialist with Novaworks Computer Systems in New York and technology fellow in the arts at Bard College. He also co-hosts the New York City After Effects Special Interest Group and creates music and animation on Macs and NTs. Contact him at rlainhart@novaworks.com.

sources

Commotion 2.0 · list price $2,495
Puffin Designs · **RAPID 3D NO. 163**

SYSTEM REQUIREMENTS:
PowerPC or G3, MacOS 8, 100MB RAM, fast video card, fast hard drive, pressure-sensitive graphics tablet (optional).

SEE RAPID 3D GUIDE ON P. 95

BY DOUGLAS A. SAHLIN

Streaming Web 3D

MetaCreations MetaStream format

Despite an immense amount of effort on the part of vendors and artists, the Internet has been slow to embrace 3D. Why? Answers are nearly as numerous as people with a vested interest in seeing the concept succeed. Most theories blame deficiencies in the content, tools, audience, or business.

Those who subscribe to the latter notion would do well to look into MetaStream, a web-savvy 3D format launched by MetaCreations (with a little help from Intel). MetaStream is a PC file format that lets you create scalable 3D graphics for delivery and viewing on the Internet. Plug-ins are available that let you export MetaStream files from Discreet 3D Studio MAX 2.0 and 2.5 and MetaCreations Ray Dream and Ray Dream Studio 5. Bryce 4.0, Infini-D 4.5, and Canoma—all MetaCreations products—export MetaStream directly. MetaCreations also plans to develop a tool kit that will allow web and game designers to leverage the MetaStream 3D open file format. (For a taste of MetaStream in action, see the *3D* web site at www.3d-design.com.)

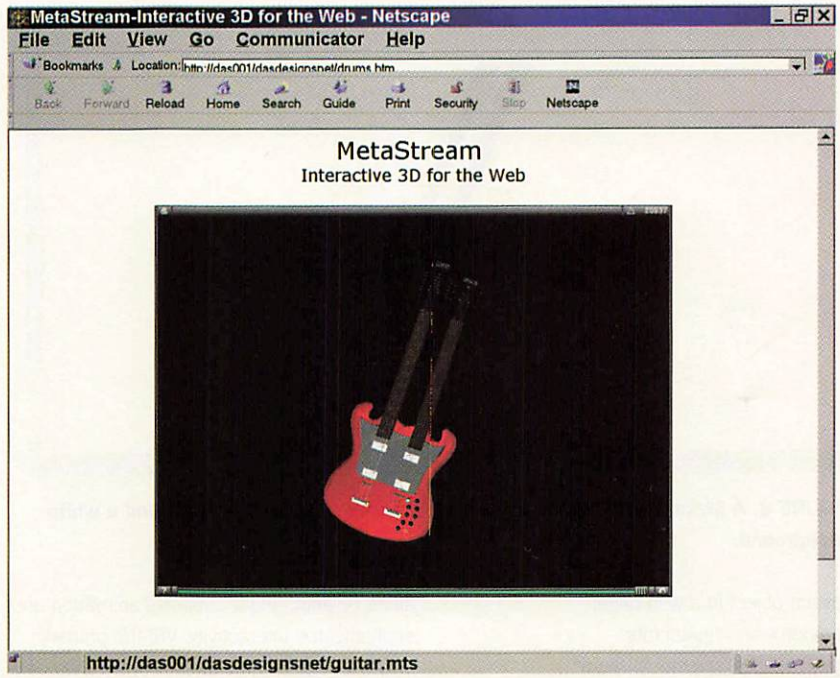

FIGURE 1. A MetaStream object presented via the default MetaStream GUI.

Audience Experience MetaStream files are extremely compact, much smaller than those associated with other Internet 3D technologies, so they download quickly. Furthermore, they appear immediately in the manner of a progressive-JPEG image, becoming more detailed as more data arrives. (MetaCreations refers to this capability as streaming.) All computation takes place on the client side, so no server-side software is necessary to deliver MetaStream content.

Web surfers seeking to view MetaStream content must download a free plug-in from the MetaCreations web site (Microsoft Internet Explorer and Netscape Communicator are supported, currently Windows only). The plug-in is small (595kB), and it can be downloaded and installed without shutting down and restarting the browser. Once the plug-in is installed, MetaStream objects can be manipulated in simple ways—unfortunately, the technology doesn't allow scene navigation or object animation.

Using various key combinations while click-dragging, audience members can resize, rotate, pan, zoom, and adjust pixel resolution. Left-clicking the MetaCreations logo in the upper left-hand corner of the MetaStream GUI (Figure 1) or right-clicking on a MetaStream object calls a menu for adjusting resolution to suit the user's processor and modem speed (Figure 2). Options include wireframe, flat shading, smooth shading, back-face culling, texturing, texture shading, animation on/off (which enables and disables rotation), and auto resolution (which adjusts resolution, including frames per second, automatically based on the CPU and connection speed). Audience members can choose to render via OpenGL, D3D, or SreeD (MetaCreations' rendering engine).

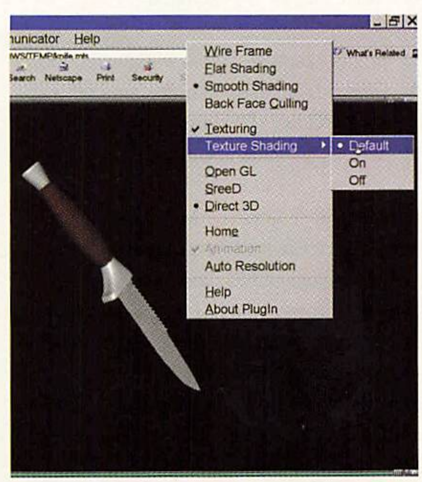

FIGURE 2. You can adjust the resolution of MetaStream objects to suit your computer and connection speed.

HTML Authoring Embedding a MetaStream object in a web page requires only a few simple commands. You can set parameters for resolution and frame rate, allowing some degree of control over your audience's viewing experience and download time. The following HTML commands embed a Meta-

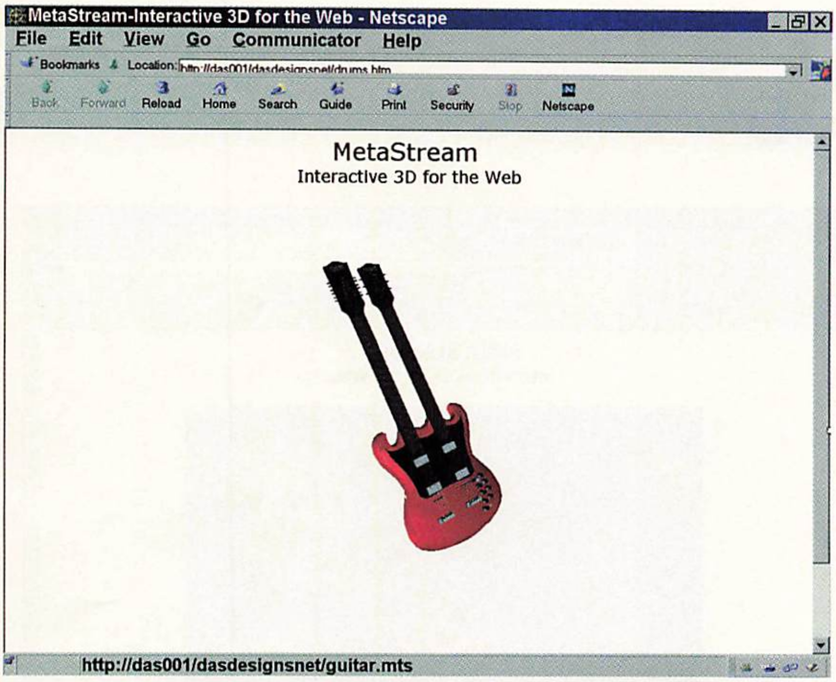

FIGURE 3. A MetaStream object embedded in a web page with no logo and a white background.

Stream object in a web page:

```
<embed> src="guitar.mts"
type="application/metastream"
width="300" height="225"
Background="255 255 255"
ui="white" logo="0" </embed>
```

In this example, shown in Figure 3, the background and user interface are both set to white and the MetaStream frame is turned off (that is, its value is 0).

Games and Commerce MetaStream provides an excellent solution for computer game developers and other Internet businesses that can benefit from quick-loading, scaleable 3D objects. Internet game developers will appreciate MetaStream's detail and smooth motion, while e-commerce developers can create online catalogs, seamlessly linking 2D images of their products with MetaStream graphics that provide a fuller experience. MetaStream is also well suited to virtual museums in which visitors can interact with 3D artwork.

MetaStream isn't without competitors. Virtual reality modeling language (VRML) files allow users to navigate a 3D world via a browser plug-in or specialized VRML browser. VRML's advantage is that it can be used to create navigable worlds as well as standalone objects, and it supports animation and sophisticated interactivity. VRML's primary disadvantage is large file sizes. A 6,300-polygon object I exported in MetaStream format weighed in at a dainty 14.5kB. The same object exported in VRML format (*.wrl* filename extension) tipped the scales at 368kB.

Apple's QTVR technology offers another way to create 3D objects—or, rather, something very close. A QTVR object is created by photographing or creating a series of images of an object from different angles and stitching them together using QTVR authoring software, at which point they can be viewed and spun in a browser window. For a QTVR object to recreate MetaStream's 360° viewing experience in all planes, a large number of images would be needed, resulting in a large file that would take some time to download, and the entire object must download before it can be viewed. On the other hand, QuickTime's installed base is enormous compared with that of MetaStream.

A very interesting competitor is Cult3D by Cycore of Sweden. Cycore offers a Cult 3D viewer plug-in to Discreet 3D Studio MAX 2 and 2.5 that enables MAX to export Cult3D content. Exported objects are compact and highly detailed, and they can be viewed from all sides. In addition, they can include animated parts, and animations can be triggered interactively. For instance, a model of a CD player can eject a CD when the eject button is clicked. Thus, visitors to an e-commerce site utilizing Cult3D can see operating versions of products. Viewing Cult3D content requires a browser plug-in, available from Cycore for Windows and Mac.

A Step Closer If you're interested in delivering true 3D objects over the web, you'll have a difficult time choosing between MetaStream and Cult3D. Cult3D supports interactive animation, MetaStream doesn't. MetaStream streams, Cult3D doesn't. Cult3D's export capabilities are currently limited to one application, while MetaStream content can be exported from six. Audience members who view MetaStream content can adjust it to suit their processor and modem speed, which is a plus.

And then there's the plug-in required for viewing content. Neither MetaStream's nor Cult3D's is widespread yet. Although neither is a painful download, any component that must be added to the audience's system raises the possibility that people will find it cumbersome to view the content you're offering. If you're seriously interested in either technology, you'll do well to watch the company's plug-in distribution strategy closely.

All told, the MetaStream experience is quite satisfying, and the technology is a significant addition to the tools available for turning the web into a 3D experience. It brings 3D artists one step closer to being able to deliver their output inexpensively to a worldwide audience.

sources

MetaStream · **no-cost license**
MetaCreations · **RAPID 3D NO. 162**

- **Plug-ins available for Internet Explorer and Netscape Navigator (currently Windows only) to view MetaStream content.**
- **Plug-ins available for 3D Studio MAX, Ray Dream Studio 5, and Ray Dream to export MetaStream files. Bryce 4.0, Infini-D 4.5, and Canoma export MetaStream directly.**

Doug Sahlin is a writer, digital artist, and web site designer living in Central Florida. You can contact him via e-mail at das001@earthlink.net.


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Phillip Miller, Product Manager for 3D Studio MAX at Discreet, formerly the Kinetix division of Autodesk

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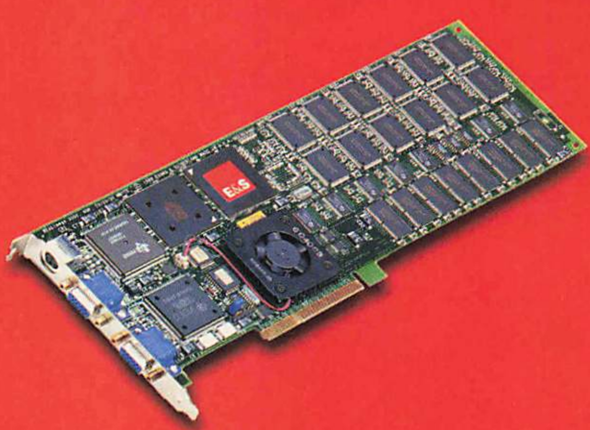

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BY SANFORD KENNEDY

Something to Crow About

Building a cartoon crow with plenty of personality in Softimage|3D 3.8.

Rendered version of Too Cool Crow, TC for short.

Some of the best cartoon characters ever created have appeared in Walt Disney's animated films. Among my favorites is the crow in *Dumbo*. This character is a smooth-talking con man who tries to give the helpless baby elephant advice that will only lead him deeper into trouble.

Creating cartoon characters like this, characters with the capacity to convey a distinctive personality, especially a humorous personality, is one of the most satisfying aspects of 3D animation. The key to building such characters is to imbue them with human characteristics that make them seem familiar to the audience. The audience should be able to recognize some of their own weaknesses in the mannerisms and attitudes of the character. A unique way of walking or an exaggerated speech pattern that pokes fun at ourselves or people we know tends to strike the funny bone.

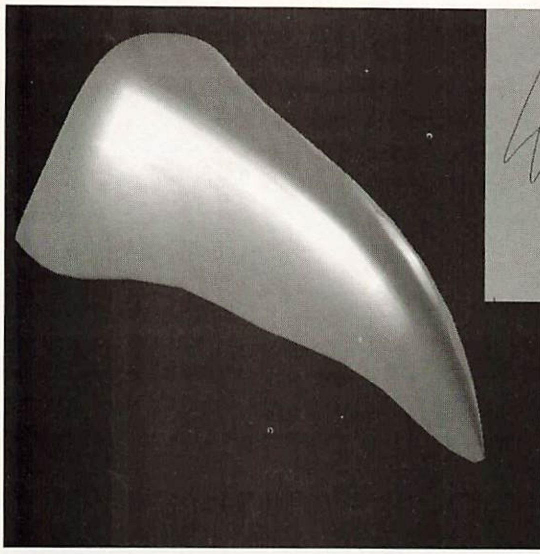
Softimage 3.8 has a unique set of tools designed specifically for character creation and animation. In fact, it's widely used to create television, game, and motion picture animations. The special features of this program make it a fine choice for resurrecting Disney's magic in a digital crow whom I call Too Cool Crow, or TC for short.

A crow character that can be animated with human expressions such as smiling, frowning, and jeering requires a flexible beak, eyebrows and eyelids, and human-like arms and hands. I'd rather not copy Walt Disney's designs, so I derived the crow's features by scanning a picture of a real crow into Adobe Photoshop and studying its characteristics. I scaled up its head and beak, scaled down its body, and gave it cartoon legs, adjusting its characteristics until I had a pleasing hybrid that combined the features of a crow with the overall shape of a human. The most important changes were to make the body pear shaped, add human clothing, and change the eyes to look forward rather than sideways. The resulting Photoshop image appears in Figure 1.

FIGURE 1. A scanned picture of a crow modified in Adobe Photoshop. The head and beak were scaled up, the body scaled down, and cartoon legs added. Then the body was reshaped, the eyes oriented to look forward, and clothing added. The result: TC Crow.

Modeling Procedure Before I started modeling, I drew front, side, and top views of the character. Then I saved them as Targa images and imported them into Softimage. I used the Tools→Image import conversion utility to convert the images into the PICT format so they could be displayed in the viewport background as rotoscope images. I modeled the character starting with the beak using NURBS. The opening or lips of the beak would be an important aspect of TC's expressive capacity, so I created enough NURBS surface control vertices along the inner edge of the beak to easily control its curvature.

I started modeling the crow's beak by drawing a profile around the upper beak with the Draw→NURBS curve tool in the side viewport. This profile would remain in the viewport as a shape reference when I turned



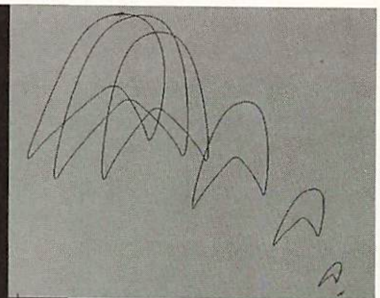


FIGURE 2. (above) TC's beak is built from translated, scaled cross sections.

FIGURE 3. (left) The NURBS surface made from the curves in Figure 2.

off the background image during the modeling process. In the front viewport, I drew a closed NURBS curve shape to create the cross section contour of the beak. I duplicated the curve to make five cross sections, then translated and scaled them along the length of the beak, scaling them down at the tip and up at the base of the beak (Figure 2).

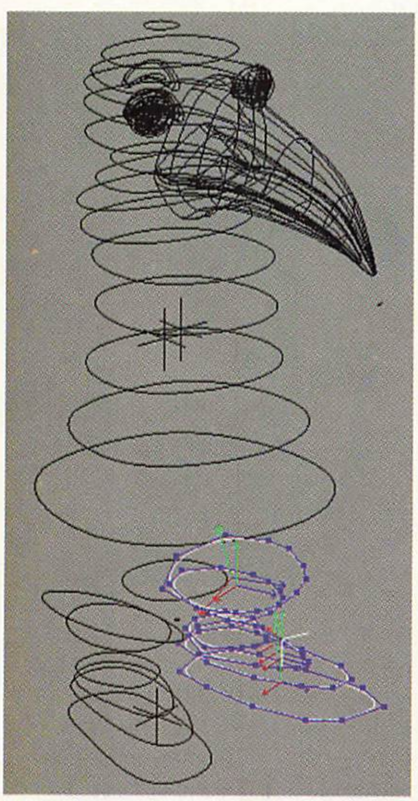


FIGURE 4. The legs were built upward from the feet. Each copied NURBS curve was scaled along the X and Z axes to create the contour of the legs.

I skinned the beak using the Surface→Skin command by picking each cross section in order, from tip to base, using the default skinning settings. Figure 3 shows the resulting NURBS surface. To create the lower beak, I flattened one of the upper beak cross sections, inverted it, and repeated the previous duplication, scaling, and skinning process.

The body and head were built as a single NURBS surface. Again, I started by drawing a Bezier curve profile of the body. In Softimage 3.8 for Windows NT, rotoscope background images don't scale up and down as you zoom in and out. On the other hand, profiles can be scaled up or down, providing handy shape references during modeling.

I built the cross section curves for the legs starting with the soles of the feet. After drawing one curve with 12 points, I duplicated it and moved the new curve upward slightly to form the foot's side contour. Then I repeated the process, scaling each copied NURBS curve along the X and Z axes to create the contour of the legs (Figure 4). I continued this process, duplicating and moving curves sequentially upward until I reached a point just below the bottom of the body.

To model the body, first I drew a new curve with 22 points. I duplicated it and moved it upward, scaling to conform to the outline shape of my reference curves. I duplicated additional curves to build the remaining 14 cross sections needed to skin the chest, shoulders, neck, and head. Even though Softimage 3.8 can skin curves with different numbers of points, I wanted to maintain the same number of points in each cross section so the NURBS control points would be aligned with each other. This also resulted in a well-parameterized surface, making for a smooth, undistorted skin.

Using the Surface→Skin command, I skinned the NURBS curves starting with the legs. I set the bottom end of the surface closed and the top end open. Then I moved up to the body and skinned it separately, closing both the top and bottom ends. The next step was to attach the legs to the body using a blend to curve the surface. I created a projection curve from the top-most leg curve and used the Draw→Project On NURBS Surface command to place a curve on the lower body surface. It was necessary to create a second projected curve at the top of the leg before the blend surface could be generated successfully. Once the first leg blend was done, I repeated the process for the other leg, adjusting the blend surface tangent values to obtain a smooth surface at

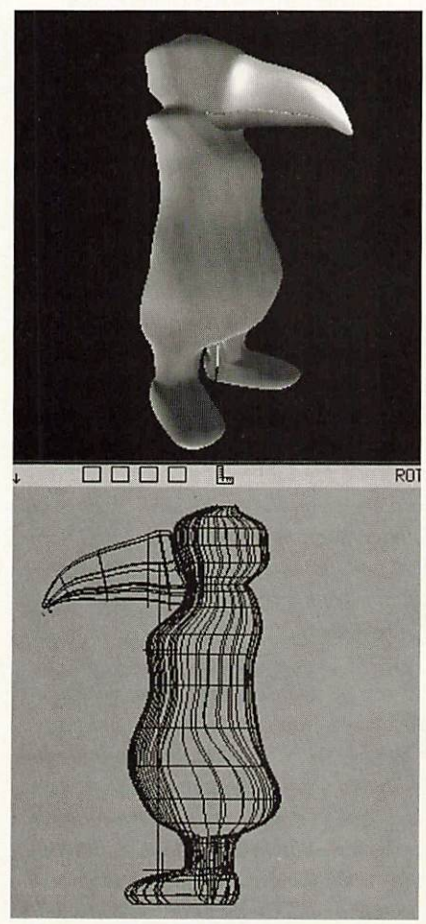
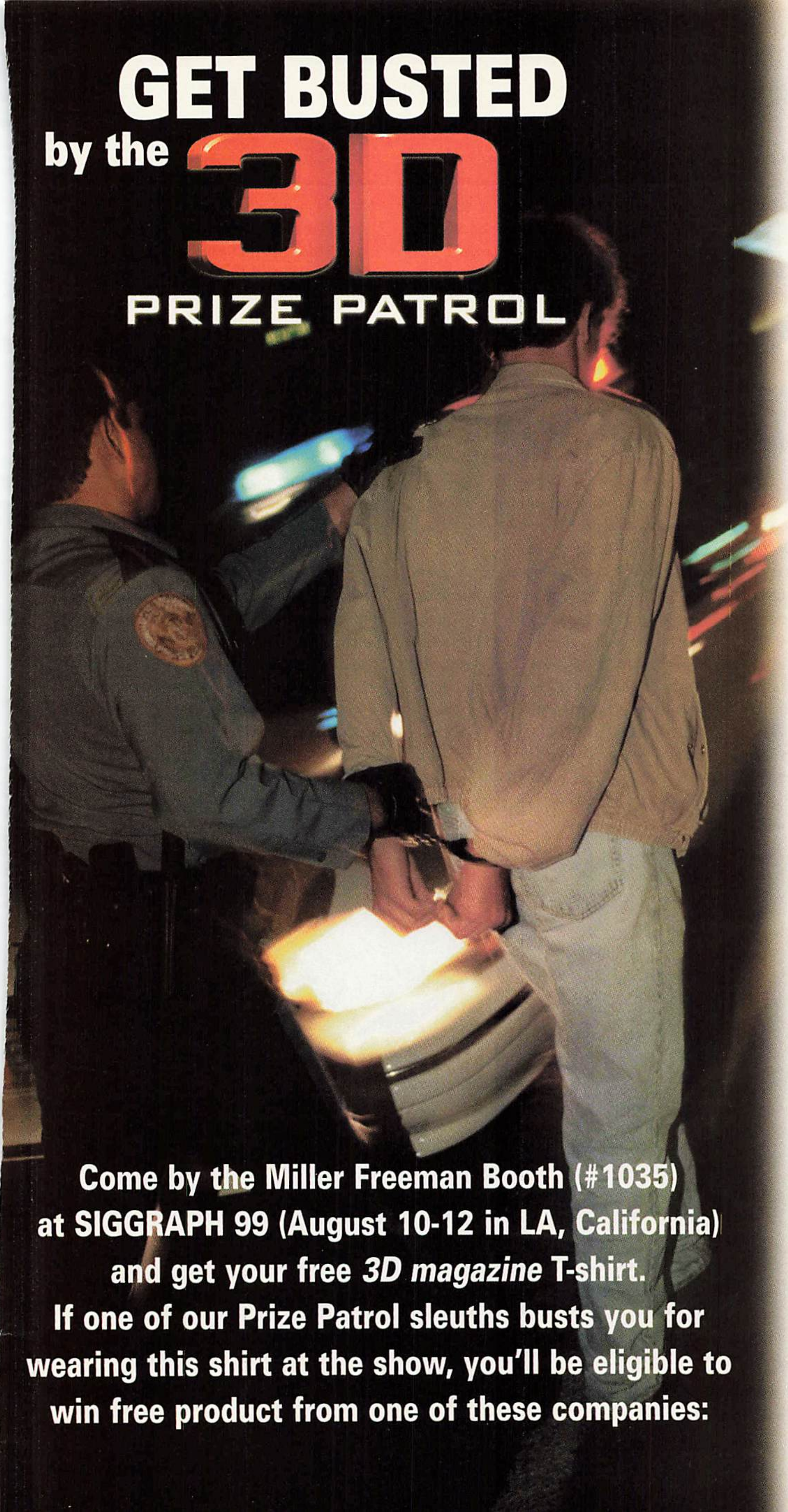


FIGURE 5. The skinned body surface, including the beak. The legs were skinned separately from the body then attached via shape blending.



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the edges of the blend. Figure 5 shows the skinned body surface including the beak.

Skinning left some unwanted bumps. I reshaped the NURBS curves in the shoulder and head area and reskinned the model several times before I arrived at the final shape.

Look Ma, No Wings! This crow has arms rather than wings. I decided to build the model with its arms bent and resting on the umbrella, instead of positioning them in the classic Leonardo pose, raised up and pointed out to the sides.

The arms were built by drawing an oval NURBS cross section curve, then duplicating it and positioning the curves along the left side of the crow's body where I wanted the arms to be. I adjusted the scale of curves and skinned them, and then used the Effect→Symmetry command to create a mirror copy for the right side. Figure 6 illustrates the arm cross sections and the wireframe view of the resulting NURBS surface.

The hands were built as polygonal box models instead of with NURBS. I did this because I wanted to experiment with using Softimage's Shape animation capabilities, morphing the hands to open and close the fingers. I built the left hand starting with a primitive polygonal cube. I scaled it into a long rectangle to form the palm of the hand. Next, I divided it into four long sections using the Effect→Subdivision tool and set the Z axis value to 3. This provided four polygonal faces at the end of the box to use as fingers.

The finger shapes were extruded by selecting the polygons at one end of the box and duplicating them. Then, in polygon mode, I translated them in the X axis to extend them outward. I did this repeatedly to form additional short sections to build the finger bones and joints, using more polygons at the joints where the fingers would bend. After the basic finger shapes were long enough, I smoothed them using the Effect→Rounding tool.

The thumb was created in the same way as the fingers, extruding outward from a single polygon on the side of the palm. When it was finished, the mesh had way too many polygons, so I applied the Effect→Polygon Reduction command. This tool reduced the number of polygons in the hand from roughly 8,000 to 1,800 (Figure 7). Any further reduction in the number of polygons at the joints would have made it difficult to bend the fingers smoothly later, when I did the Shape animation.

To serve as Shape targets, I made three duplicate left hands. I modified them to form a hand reaching, a hand grasping the brim of the crow's hat, and a hand wrapped around handle of his umbrella. Because the right hand would remain resting on the umbrella during the animation, I made the right hand by duplicating and mirroring the umbrella-holding shape target.

A Sly Face In simple cartoon characters, most emotional expression is done with broad movements and gestures, supported by the dialog and sound effects. With the advent of computer-generated 3D animation, subtle facial expressions and close-up shots can be used, making animated characters more interesting and lifelike. The eyes are the center of attention in many animated characters, usually highly mobile and larger than life-sized. TC Crow's eyes are very large, but they remain half-lidded to give him a sly, calculating look.

I placed large white eyes on the surface of the head below a thick eyebrow ridge. A real crow's eyes are black and inset smoothly into the side surface of the head. I built TC's eyes by drawing and skinning a series of four circular NURBS curves. The eyes were placed on the head surface fac-

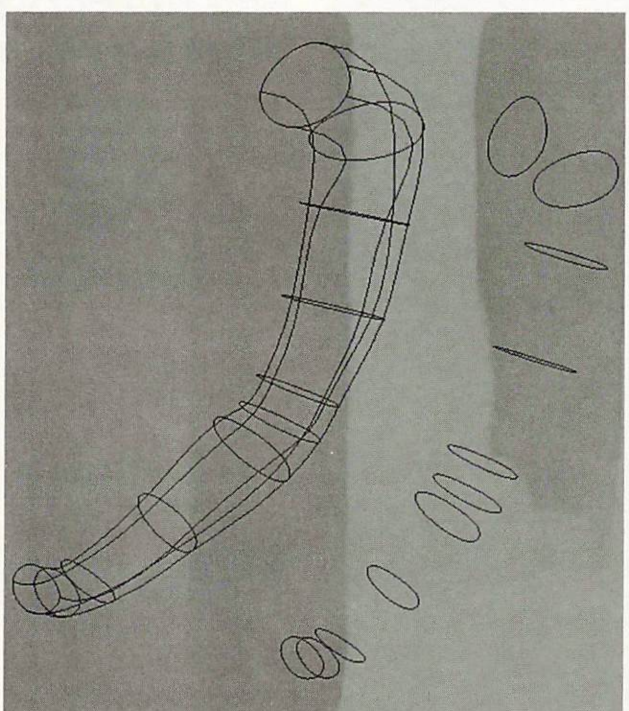

FIGURE 6. The arms were built by duplicating and scaling an oval NURBS cross section curve to make a skin surface.

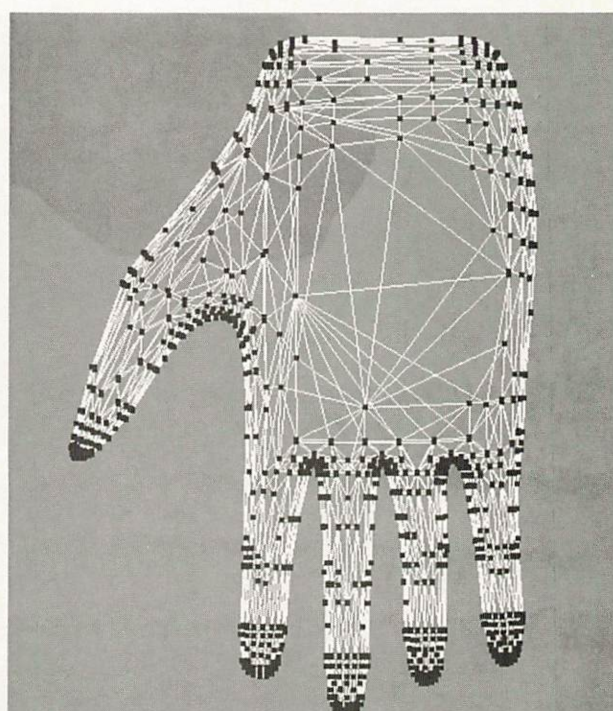

FIGURE 7. The hand was built as a polygonal box, with fingers extruded by translating them in the X axis.

FIGURE 8. Unlike a real crow, TC's eyes are white and face forward. They're built from four circular NURBS curves.

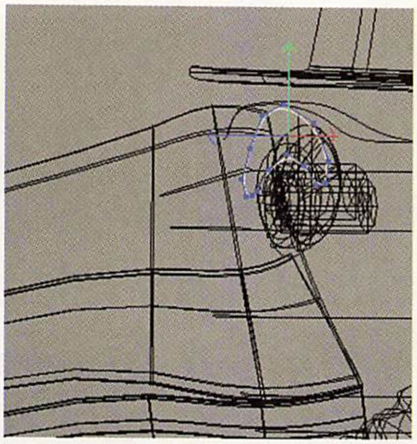

FIGURE 9. The eyelids are a set of four skinned NURBS curves formed into an arc shape for a heavy-lidded look.

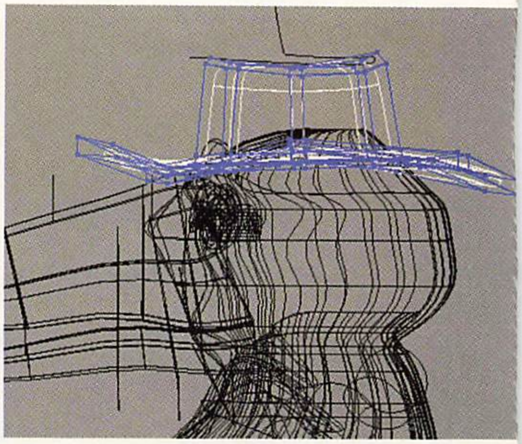

FIGURE 10. The hat is the only NURBS object that was made by revolving a curve, also known as lathing.

ing forward (Figure 8). I built the eyelids by drawing and skinning a set of four NURBS curves formed into an arc shape for the heavy-lidded look I was after (Figure 9).

The hat is an integral part of the crow's appearance. It accents the shape of his eyes and beak. It's the only NURBS object in the model that was made by revolving a curve, also known as lathing. The brim of the hat was modified to produce a stylized floppy look by moving the control vertices and thickening the surface (Figure 10).

Clothes Make the Crow The Crow's vest was modeled using a number of the NURBS curves from the crow's body. When you skin NURBS curves, Softimage 3.8 leaves the original curves in the file, and you can use them later to create more skinned objects. I selected all the curves from the crow's waist to its neck, then hid all the other objects in the scene. I reskinned these curves to create the NURBS surface that would become the vest. Then I scaled it roughly 15 percent larger in X, Y, and Z dimensions to make it fit easily over the crow's body. Finally, I applied a light tan color to contrast the vest with the dark brownish-black that I had applied to the body surface.

Before trimming the edge of the vest into shape, I unhid all the objects in the scene. I was pleasantly surprised to see how well the untrimmed vest surface object fit the body.

To finish the vest, I needed to trim the edges to create a curve around the bottom edge and then form the lapels. I grabbed

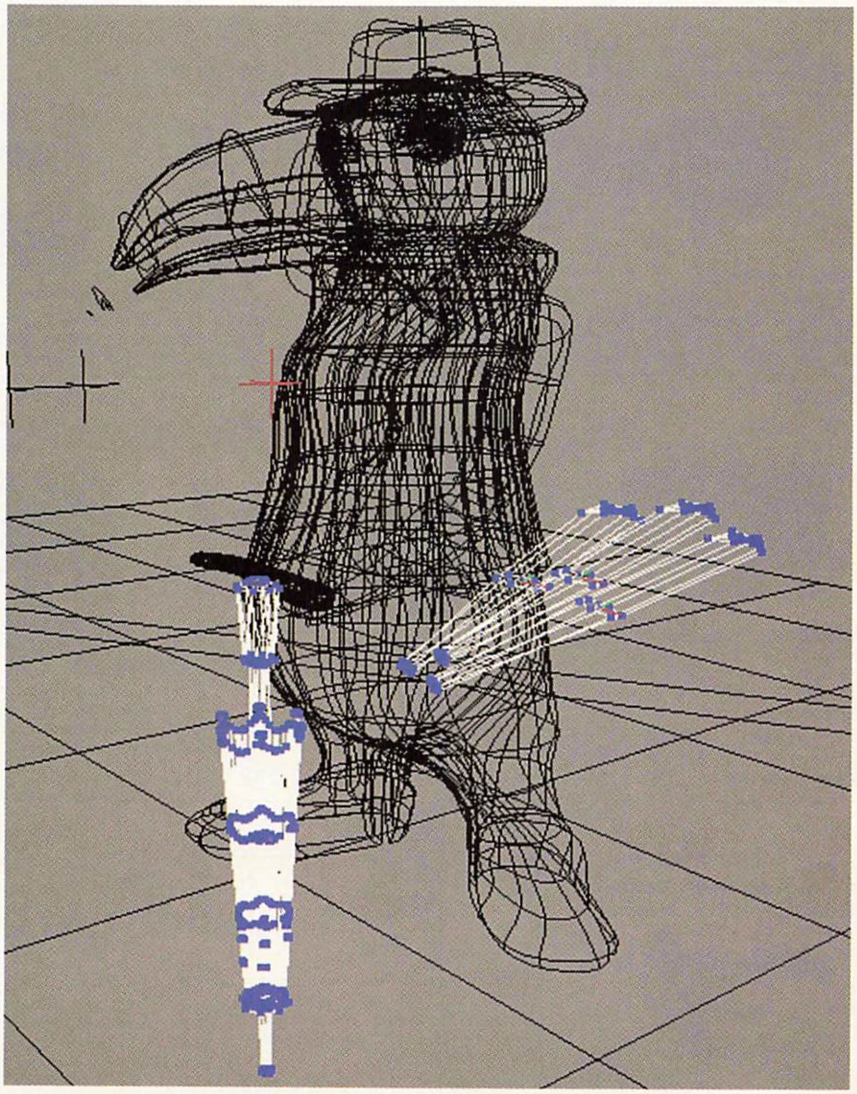

FIGURE 11. The umbrella shaft, handle, and bows are primitive polygonal cylinders. The umbrella cloth is NURBS converted to polygons. The crow's tail feathers were made from three primitive cylinders that were scaled down in one axis to flatten them.

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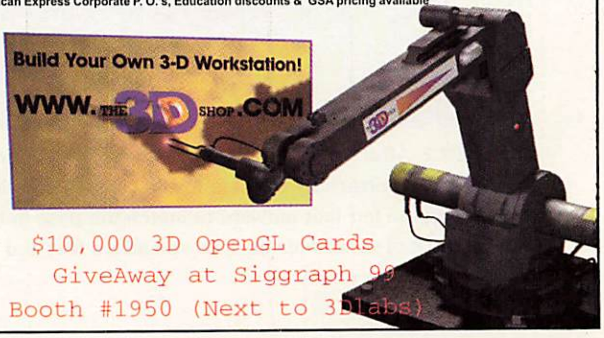

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control vertices in the areas I wanted to cut away and simply pulled them inside the body surface. The result looked as though I had cut away the vest's surface. I made sure to pull the shoulder-hole control vertices inside the body as well to create arm holes while keeping enough cloth around the shoulders to hide the joint where the arm joined the body.

Finishing Touches All that remained were the umbrella, the tail feathers, and the background setting. The umbrella shaft, handle, and bows were made from primitive polygonal cylinders. The umbrella's cloth was fashioned out of a skinned NURBS surface created from two curves and converted to polygons. The crow's tail feathers were made from three primitive cylinders that were scaled down in one axis to flatten them and tapered lengthwise. I sculpted the wide ends to round them like real feathers. I didn't try to make a realistic tail; instead I positioned the feathers to visually counterbalance the weight of the crow's beak (Figure 11, p. 84).

The floor and back wall on which TC stands were built from primitive cubes that were scaled to create panels that could be texture-mapped to contrast with the crow and receive his shadow. This way, he would appear to be standing on the ground.

To finish the model, I applied solid-colored materials to each object using custom Material settings in the Matter module. The body, hat, vest, and eyes were assigned Lambert-shaded materials, which don't have a specular highlight, giving the objects a soft appearance. The crow's beak was assigned a Phong-shaded blackish-brown material with a yellow-brown specular highlight that looked a bit like plastic. The umbrella was also assigned a Phong-shaded material with highlights. The background panels were textured using bitmaps to create the floor tiles and the old stucco wall.

Crow Motion After the model was finished, it needed to be set up for animation. This involved building a skeleton, assigning a flexible envelope for the grouped skeleton and surface geometry, and then making sure the vertex assignments were weighted correctly to allow the crow's skin to deform smoothly without buckling at the joints. After building the skeleton using the Actor→Skeleton→Draw 3D Chain command and attaching the skin to the bones, I created the character's first position by rotating the left foot outward to match the pose in my original drawing. Then I moved the foot toward his back to spread his feet and distribute his apparent weight more evenly (Figure 12).

The animation I planned to create would have the crow reach up with his left hand, take off his hat, tip his head toward the audience, and then smile while shifting his weight and striking a new pose with the umbrella. This very human-like motion is actually quite complex because everything happens at once. Since this article only covers how to build a cartoon character, I'll set aside the process of setting up the skeleton and the deformation envelope. You can download the finished animation from the *3D* web site (www.3d-design.com).

Building TC Crow was a challenge, especially the legs and lower portion of the body. Nonetheless, it was enough fun that I'm working on a companion character, Jason Lump, an easily fooled kid who's always being tricked into doing TC Crow's work while the old bird sits back and watches. Both characters are parodies of people in my own life, which (for better or worse) provides me with a deep well of possible cartoon characters and situations.

Softimage 3.8's character creation tools made the creation of TC Crow fast and efficient. The challenge ahead will be to record dialog and animate TC Crow with lip sync to bring him to life.

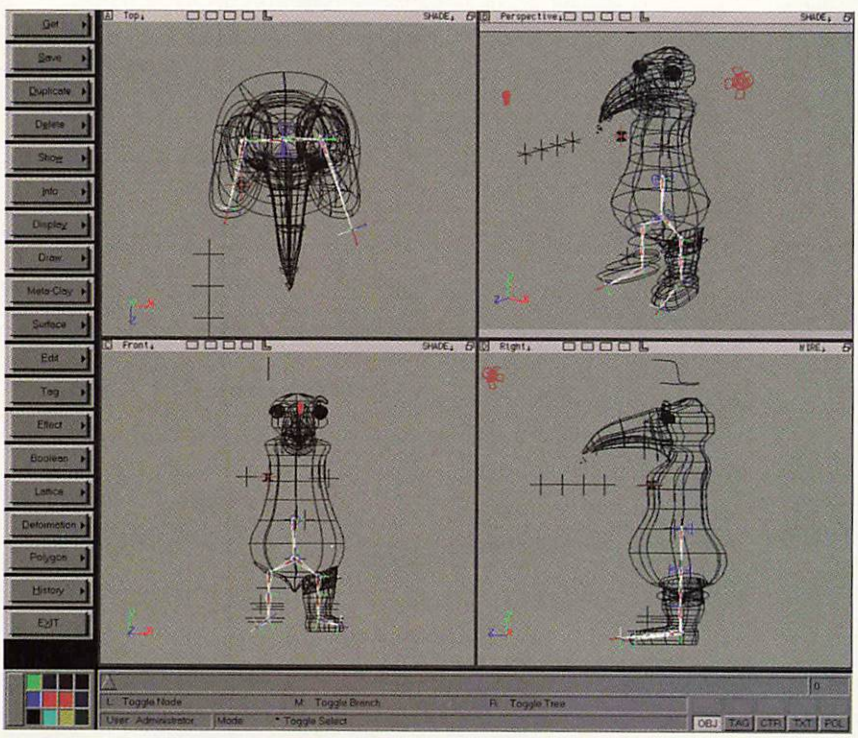

FIGURE 12. After building the skeleton using the Actor→Skeleton→Draw 3D Chain command and attaching the skin to the bones, I created the character's first position by rotating the left foot outward to match the pose in my original drawing. Then I moved the foot toward his back to spread his feet and distribute his apparent weight more evenly.

Sanford Kennedy has 20 years of experience in film effects both practical and computer-generated. He is principal of Sanford Kennedy Design, a CG studio in Los Angeles, and teaches 3D Studio MAX at Art Center College of Design in Pasadena, CA. Email him at sanken@concentric.net.

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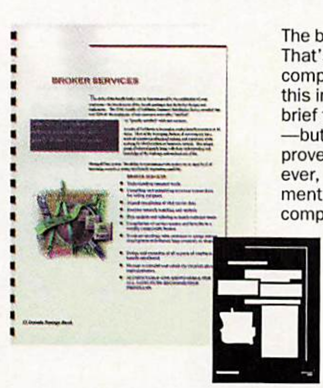

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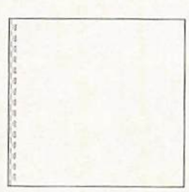
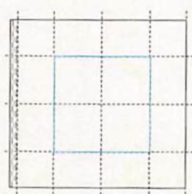
Blue geometric cube is the company mark. Which of these three typefaces coordinates best? (Answer at the end)



Begin with an element that already exists. In this case, the cube is a square, so let's make the page square.



Next, make the live area square, on center, which yields "square" margins.

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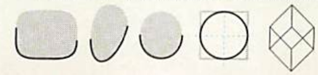
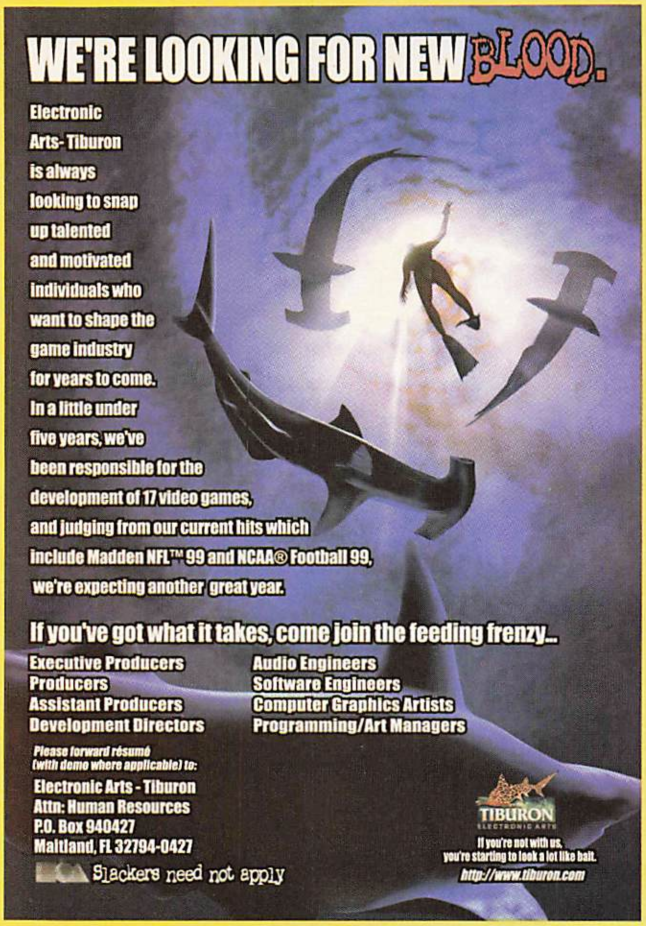
What typeface works best? Look for simple relationships. A circle, the basis of Futura, has most in common with our square—center, axis, radius, simplicity. The other two typefaces have multiple-radius curves, thick-thin strokes, and so on. Their relationship to the square is complex, ambiguous and unattractive.





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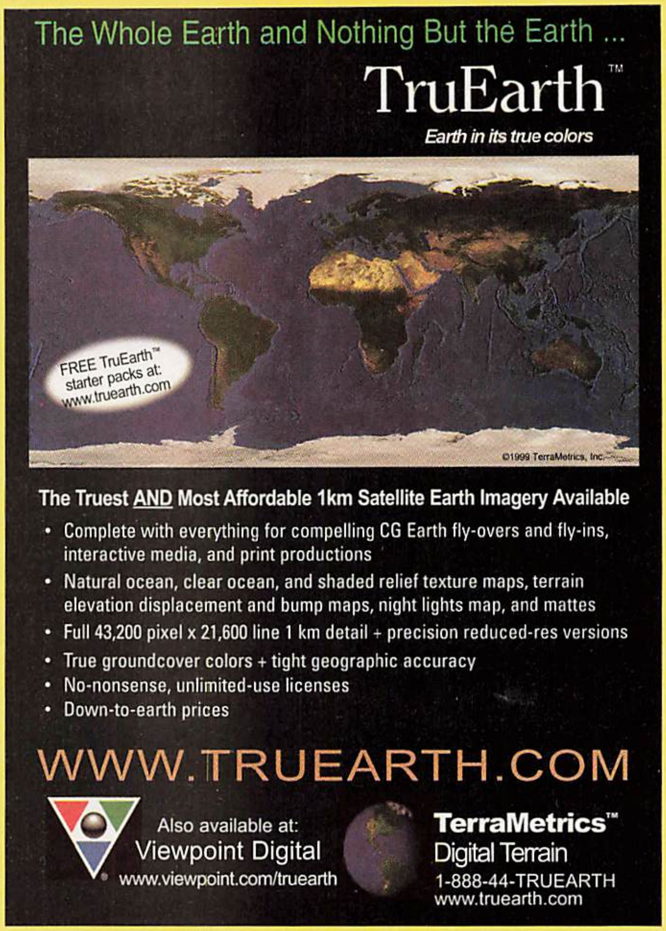

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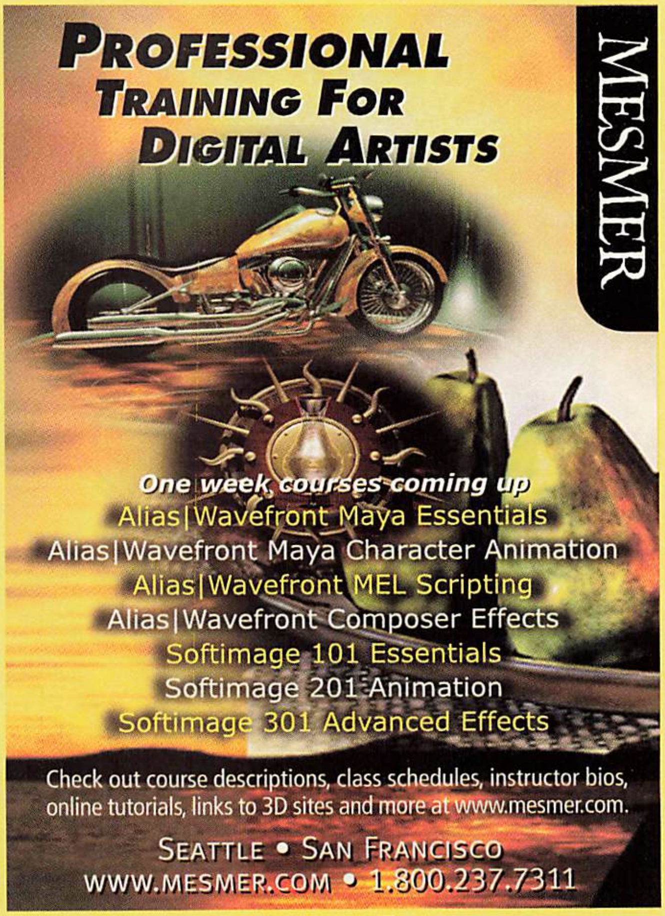

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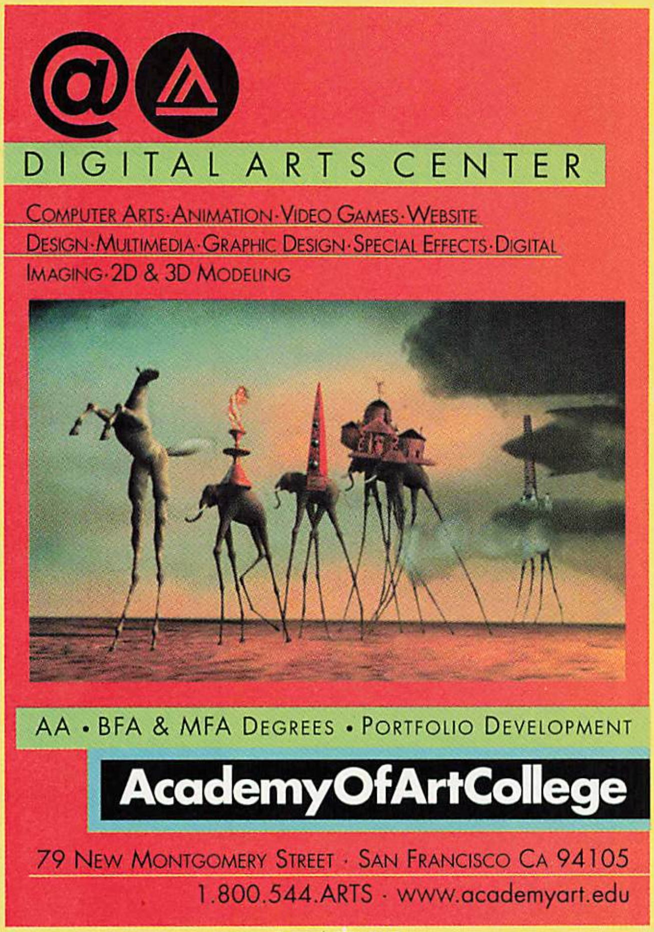

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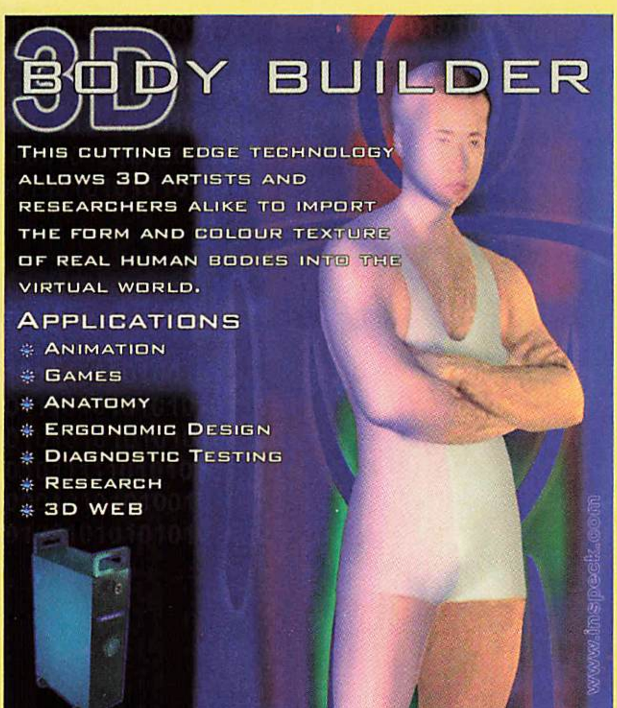

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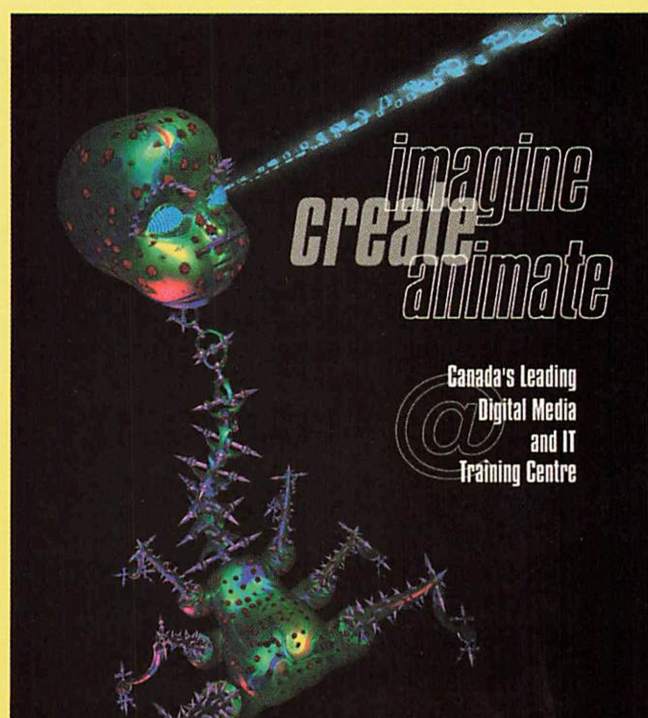

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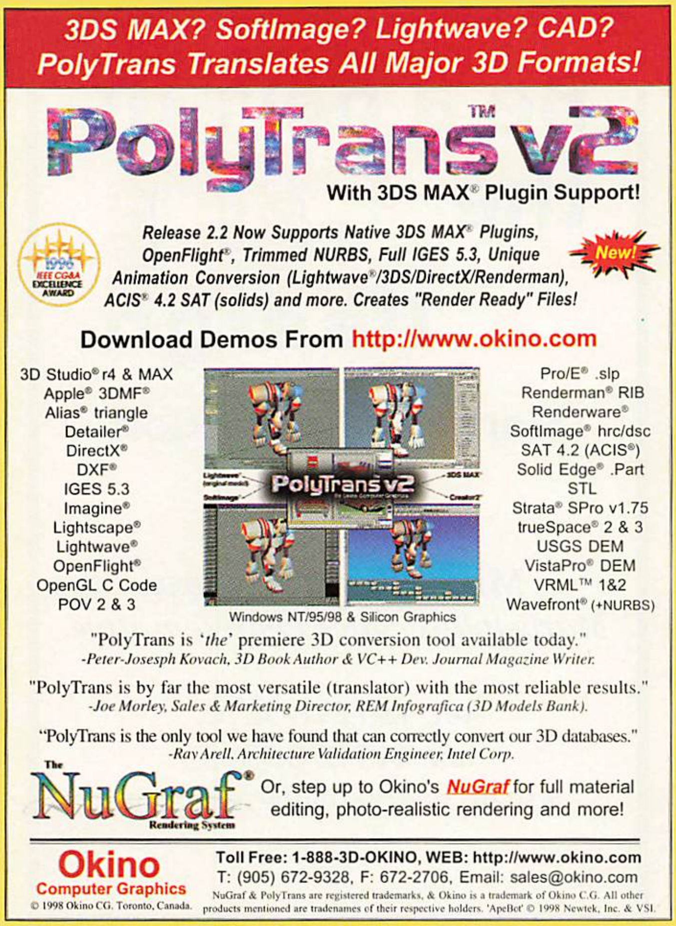

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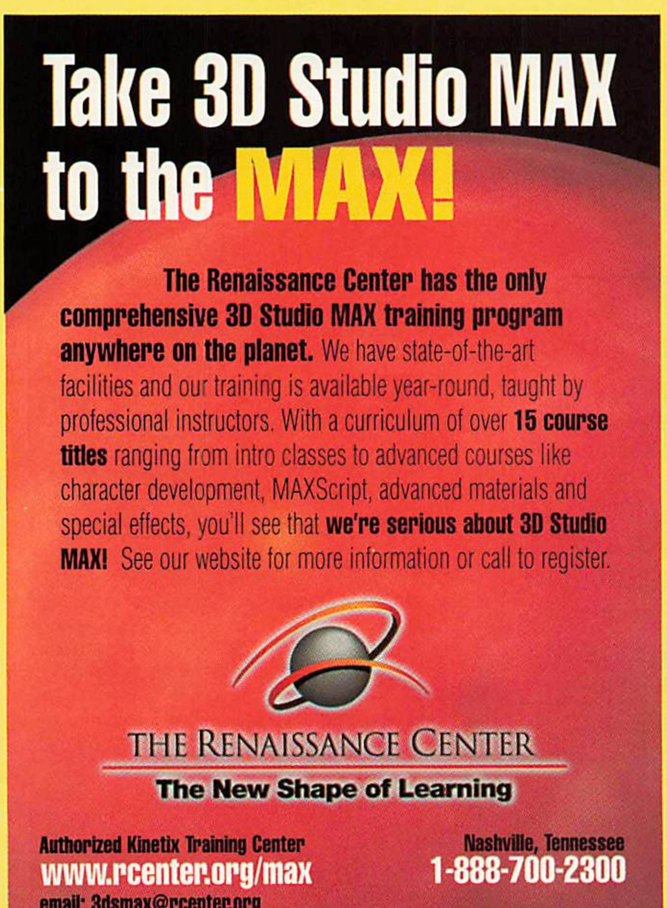

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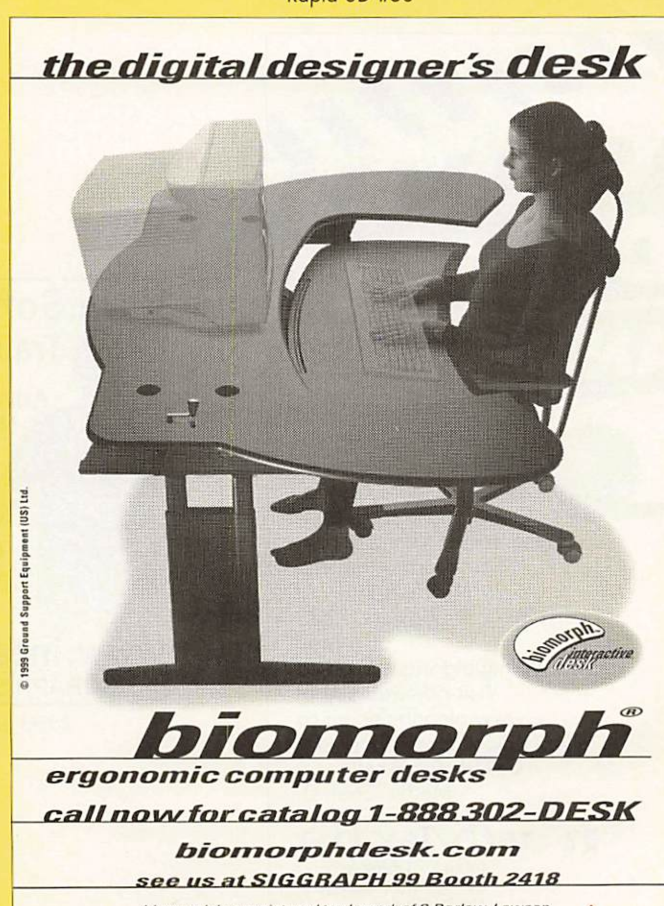

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MetaCreations
RAPID 3D NO. 162

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Digimation
RAPID 3D NO. 155

Photoshop 5.5
Adobe Systems Inc.
RAPID 3D NO. 159

QuickDirt
Digimation
RAPID 3D NO. 154

SGI 540
SGI
RAPID 3D NO. 151

Softimage|3D 3.8
Avid
RAPID 3D NO. 164

3dfx
RAPID 3D NO. 178

Alpha Processor Inc.
RAPID 3D NO. 179

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RAPID 3D NO. 175

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RAPID 3D NO. 171

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RAPID 3D NO. 174

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RAPID 3D NO. 170

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BY CHRIS TOME

RTFM (If You've Got It)

Resources such as manuals and reference guides are a big help when it comes to learning 3D programs, but they aren't available to certain users. Why? Chances are, a user without a manual is a pirate. When pirates go hunting for info on their pilfered apps, they turn to the Net for help, and hence, to many legitimate users who don't take kindly to pirates. The usual answer is a curt and terse reply: RTFM, which stands for Read The F***ing Manual. In other words, get bent.

Piracy is a heated subject, and although many software companies and industry organizations insist that it's a black-and-white issue of wrong and right, I see many gray areas. Before I go any further, though, let it be understood that I do not advocate software piracy. This form of intellectual property theft is basically the same, in my opinion, as distributing one of my pieces of artwork without paying me. Needless to say, it would make me one extremely unhappy camper.

Does this mean the FBI should come barreling into some 12-year-old kid's house because he's making Quake characters with a cracked copy of Maya? Of course not. In this hypothetical (but very common) scenario, the kid may be a game freak who's bored with playing games and now he wants to make them, only he has no intention of buying a $7,500 3D app. Will pirating software lead this kid to a life of crime? It could, but it's not likely. Will this "lost revenue" bankrupt the software company? Since there never was a chance of this person buying Maya, there was no revenue lost. The software company might actually make a small amount of money off this kid from royalties on an *Inside Maya* book.

One of my relatives is a programmer who doesn't buy any software before he's had a couple days to see if it meets his needs. Is this piracy? The Software Publishers Association (SPA) would say yes, but I say no. My relative doesn't have a thieving bone in his body. He's also no idiot, and shelling out hundreds of dollars or more for a program sight-unseen is, in his mind, insane. I agree. If he likes the app, he buys it. If he doesn't, it's blown away faster than it was loaded, and that's that. No loss of revenue, and the companies that create the software he needs reap the benefits, as well they should. Many companies now offer trial versions that give you enough experience with a product to decide on a purchase, so you don't have to "pirate" software just to check it out.

A bane to legitimate users everywhere, and only a minor inconvenience to pirates, is the hardware lock, more commonly known as a dongle. Attached to a port on your computer, a dongle contains a chip that is keyed to your copy of the software. When the program is launched (and at other times as well), the app makes a call to the dongle. If it finds the dongle, the program will function normally. If it doesn't, the program won't work. Unless of course, it's a cracked copy.

Coders and hackers worldwide crack software programs, making the dongle unnecessary to run the program. This is usually done not for profit, but for the sheer thrill of hacking; it's a challenge that many coders find irresistible. Most people I know in art schools today had to scrimp and save for their computer hardware, yet they have every 3D app in the known universe loaded. These are not bad people. They are starving-artist types who can barely afford a PC, let alone the software they need. Does this make it right? Of course not. But it is the way things are, and software companies understand this, as much as they may not like it. These student pirates may find work after graduating, and they may tell their new employer they need a certain program (a legal copy, that is) to get the job done, mostly because they're familiar with that particular app. This, in a roundabout fashion, creates a sale the software company might never have had otherwise.

I spoke to Sandra Boulton, director of piracy prevention for Autodesk, developers of AutoCAD and 3D Studio MAX and one of the most aggressive anti-piracy companies around. Although the official policy at Autodesk is that all software piracy is bad, that 12-year-old kid, in Boulton's words, "really isn't on our radar." Companies like Autodesk spend their time going after people who illegally sell their software, use illegal copies commercially, or break hardware protection. Boulton also said she could see how smaller companies might look at piracy as a marketing opportunity, even if they'd never admit it, but given Autodesk's size and user base, this was definitely not a factor. Boulton speculates that for every legitimate copy of MAX, five to seven illegal copies are in use today.

So piracy is rampant. There's no way to stop it, and hardware locks only inconvenience legitimate users. What can be done? First, companies should continue to focus on those people who are illegally duplicating software and distributing it for profit. These people are no different than car thieves, burglars, or any other scum of the earth who would think nothing of robbing you blind. Second, the companies should continue to offer steep educational discounts on their software because, after all, students are their future potential (and paying) customers. These discounts shouldn't be just for college students, but for any student with proper school ID. Third, the companies should forget about dongles, one of the most irritating, useless technologies ever invented. Dongles do nothing but aggravate legal owners of software. They sure don't stop piracy.

Chris Tome is technical editor of *3D* magazine and thinks the SPA's slogan "Don't copy that floppy" is extremely outdated, especially for iMac users. Send him dongle horror stories at ctome@mfi.com.

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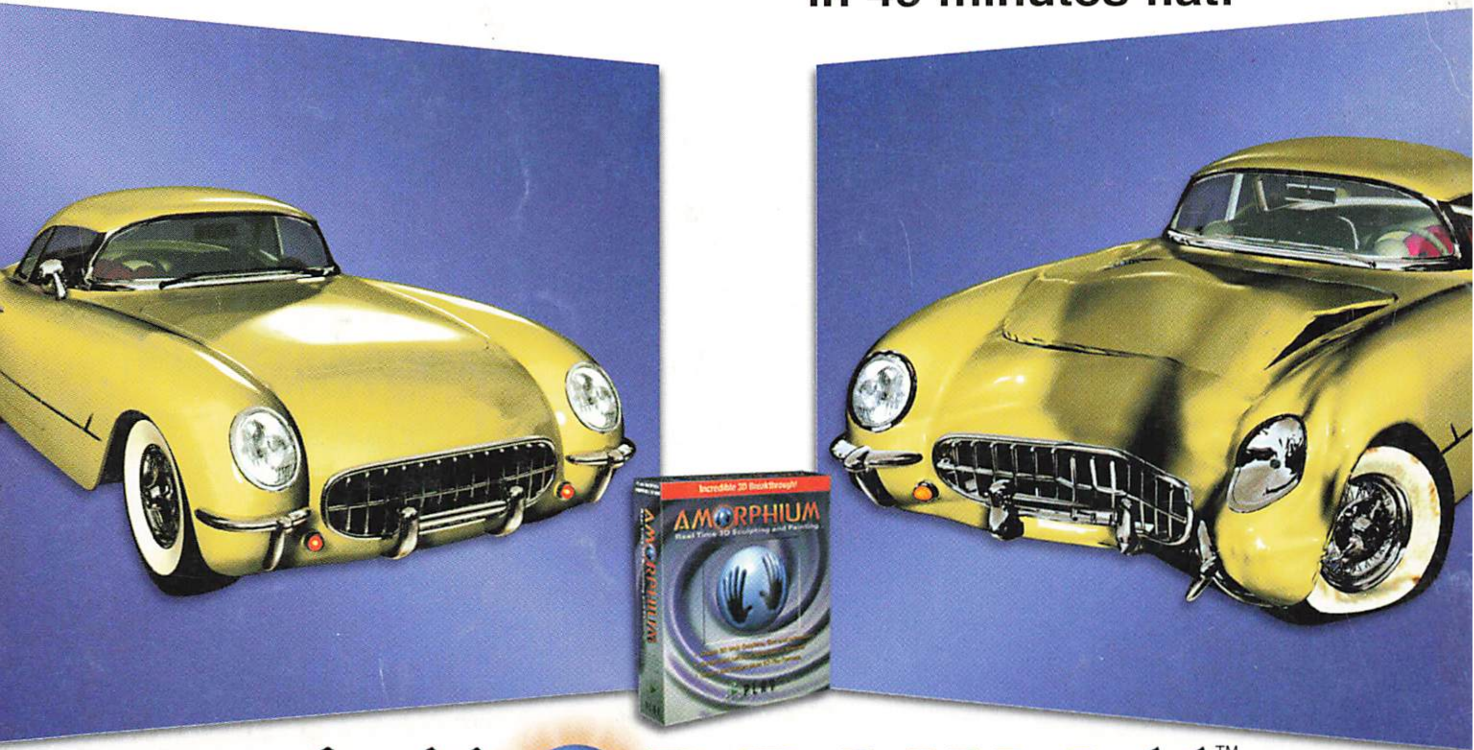

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